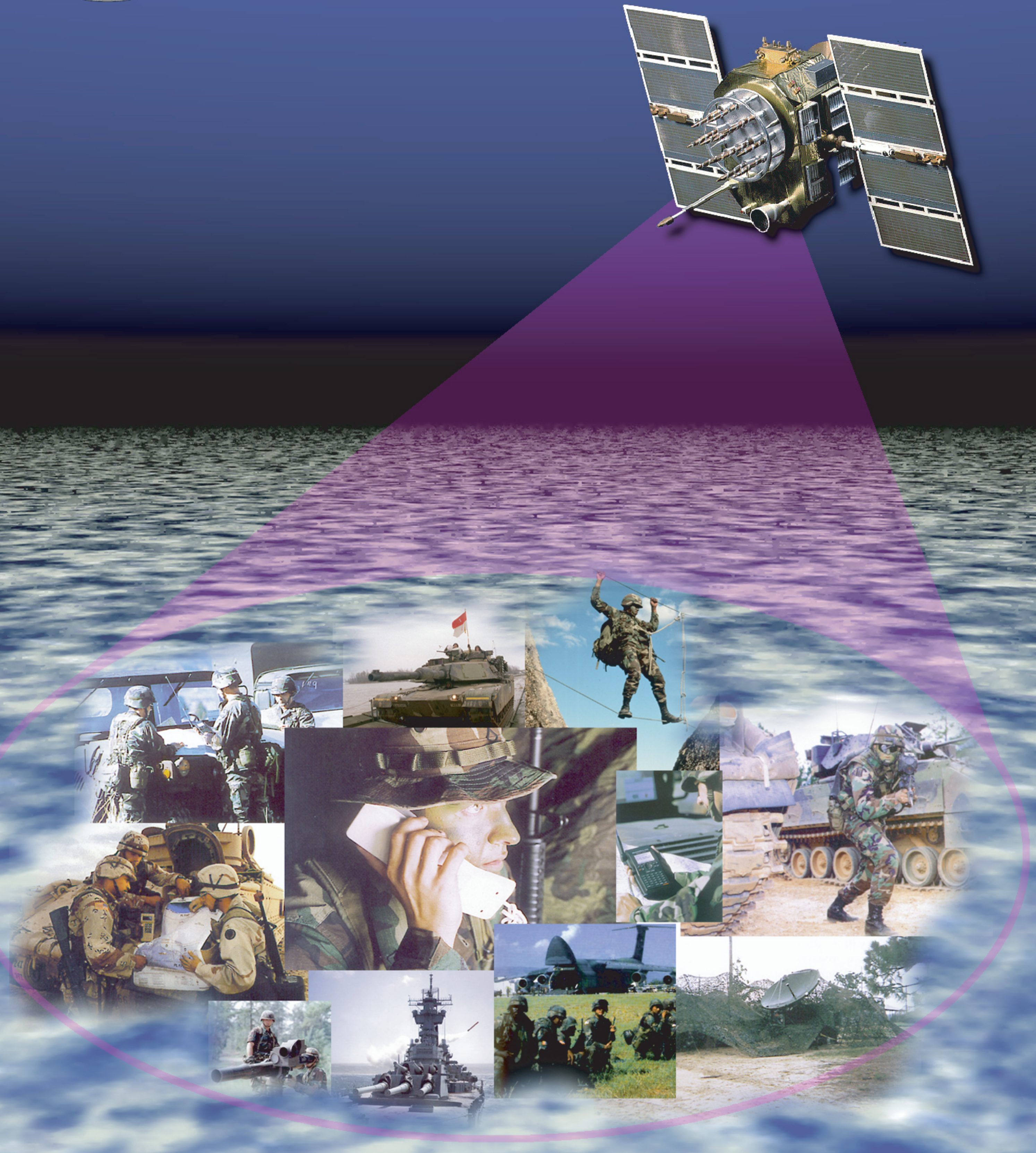
United States Army Space Master Plan



ARMY SPACE POLICY JULY 1994

Future success of Army forces will be critically dependent upon exploitation of space assets, capabilities, and products across the entire spectrum of military operations. In an environment of rapid political, technological, and economic change, Army access to national, civil, allied, military, and commercial space capabilities and products is essential to successful operations.

Consistent with National and Department of Defense policies and in cooperation with other services and agencies, the Department of the Army will conduct space and space-related activities that enhance operational support to warfighters and contribute to successful execution of Army missions. Furthermore, the Army will consider space to include those regions from, through, or in which space or space-surrogate systems operate. Employment of space products that meet land warfighter requirements will provide a force multiplier essential to our power projection force. Information technology which enables success on the battlefield relies heavily on space solutions. Beyond affecting future space systems design and developmental initiatives, the Army, in joint and combined operations, will organize and train Army forces using space capabilities and products to make them more responsive, flexible, interoperable, survivable, and sustainable. Space and space-related capabilities are essential contributors to Army modernization objectives. In addition to exploiting space systems, the Army will ensure that new systems support land component requirements. Space applications will be embedded in Army doctrine, training scenarios, wargames, exercises, and plans. The use of space products will be normalized in the preparation for and conduct of assigned missions.

Successful execution of this policy requires developing, maintaining, and enhancing Army space expertise, to include provision for training of space-knowledgeable soldiers and civilians and the development of space concepts, doctrine, requirements and equipment. The Army will seek to normalize the direct and immediate in-theater response to commanders from evolving space-based capabilities.

Aggressive exploitation of space capabilities and products normalized in concepts, doctrine, training, operations, and modernization will ensure that the Army is able to maintain land force dominance well into the 21st century. The Army's future is inextricably tied to space.

Gordon R. Sullivan
General, United States Army
Chief of Staff

Togo D. West
Secretary of the Army

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FOREWORD

Space is the high ground today, tomorrow, and in the future. Space is also a complex environment in which a multitude of nations, corporations, and international consortia conduct a wide range of space operations for economic and military benefits and compete for dominance. If the Army is to maintain overmatch capabilities, space systems must be shaped and influenced to provide the information and support our forces require to conduct decisive operations across the full spectrum of conflict.

The Army Space Master Plan (ASMP) is our first step toward attaining the operationalization, institutionalization, and normalization of space for the warfighter, and implementing a coherent, joint space strategy to support the Army's vision for a strategically responsive force that is dominant across the full spectrum of operations. The ASMP fully incorporates the goals of Joint Vision 2010 and the U.S. Space Command's Vision 2020 and Long Range Plan.

The rapidly transforming Army of the 21st century relies on the exploitation of space to enhance the versatility, agility, and lethality of its strategically responsive forces. To meet these dynamic challenges, the Army's requirements for space capabilities will significantly increase. The move toward digitization and information superiority will be highly dependent upon assured access to adequate space and ground related assets and seamless integration with complementary capabilities. The Army Space Master Plan sharpens our focus in achieving the benefits and advantages from current and future space capabilities.

JOHN M. KEANE
General, United States Army
Vice Chief of Staff

Army Space Master Plan Executive Summary

Introduction

Space is no longer the frontier battleground of a future time frame. It is a medium vital to the success of today's Army operations around the globe and will require extensive Joint cooperation and coordination. Assured access to space capabilities, as well as knowledge of their limitations, is critical to achieving dominance across the full spectrum of Army operations.

Space capabilities provide operational enhancements in virtually all Army mission areas. As Army institutions develop a full appreciation of the benefits that space capabilities provide, they are making evolutionary and revolutionary progress in instituting the changes required to take advantage of space applications. This process will ensure the Army achieves the strategic responsiveness, as well as the agility, versatility, and lethality needed to conduct decisive operations in the 21st century.

Space "...is probably the most misunderstood yet vital warfighting capability" available on the modern battlefield.

— Former Vice Chief of Staff of the Army, GEN Bill Crouch

The Army Space Master Plan (ASMP) provides the overall direction and guidance necessary to implement the Army's space policy. Fully integrated within the Army's modernization strategy, the ASMP guides the Army's normalization of space operations to ensure that future space capabilities are designed to benefit the warfighter. First published by the Army Staff in 1987, this visionary document foresaw the need for the Army to get out in front of space issues and demand tactical applications to benefit the Army. The current plan builds on this foundation, ensures Jointness, and continues the Army's forward movement in space by closely linking the ASMP with Joint Vision 2010 and the U.S. Space Command's Vision 2020 and Long Range Plan.

The latest ASMP is designed to focus Army leadership and staffs at all levels to achieve the warfighting benefits of space capabilities through the goals of *operationalizing*, *institutionalizing*, and *normalizing* space within the Army. These goals will focus the Army's collective efforts to achieve the desired end state of a strategically responsive force that is dominant across the full spectrum of operations.

Inherent throughout this plan is the need for the Army to continuously leverage space systems and technologies into the Army force structure. The Army must have a well-trained and innovative cadre of space-literate personnel who understand warfighting requirements and the benefits that space can bring to the Army. All Army leaders have the responsibility to integrate space in the spirit of this plan, enabling the Army to reach its goals as set forth in the Army Vision, Joint Vision 2010, and the U.S. Space Command Vision for 2020.

ARMY NEED FOR SPACE

There is a clear linkage between the exploitation of space and the warfighter's ability to achieve success on the battlefield. To meet the challenges of the future, the Army's requirements for space capabilities will increase significantly. The move toward an agile, versatile force that is more strategically responsive will be highly dependent upon assured access to adequate orbital and ground-based space assets and seamless integration with complementary capabilities.

Space capabilities, including communications, intelligence, surveillance, reconnaissance, navigation, missile warning, and weather will contribute to the Joint Vision 2010 operational concepts of dominant maneuver, precision engagement, full dimensional protection, and focused logistics, as well as the evolving mission area of information operations.

The medium of space and space products are increasingly a critical consideration for leaders and planners at all levels. As the Army evolves into the 21st Century full spectrum force of choice, soldiers must be trained to understand the potential benefits and combat multipliers derived from space assets and to use them effectively. Space capabilities will significantly augment terrestrial capabilities to achieve dominance across the full spectrum of operations. As the familiarity of space-based capabilities begins to influence tactical thinkers, the Army will mature its doctrinal approaches to capture space supported concepts and procedures.

The emerging synergy of space, land, sea, and air superiority will enable the Army to "dominate the full range of military operations from humanitarian assistance through peace operations, up to and into the highest intensity conflict" thus achieving Full Spectrum Dominance

— Joint Vision 2010

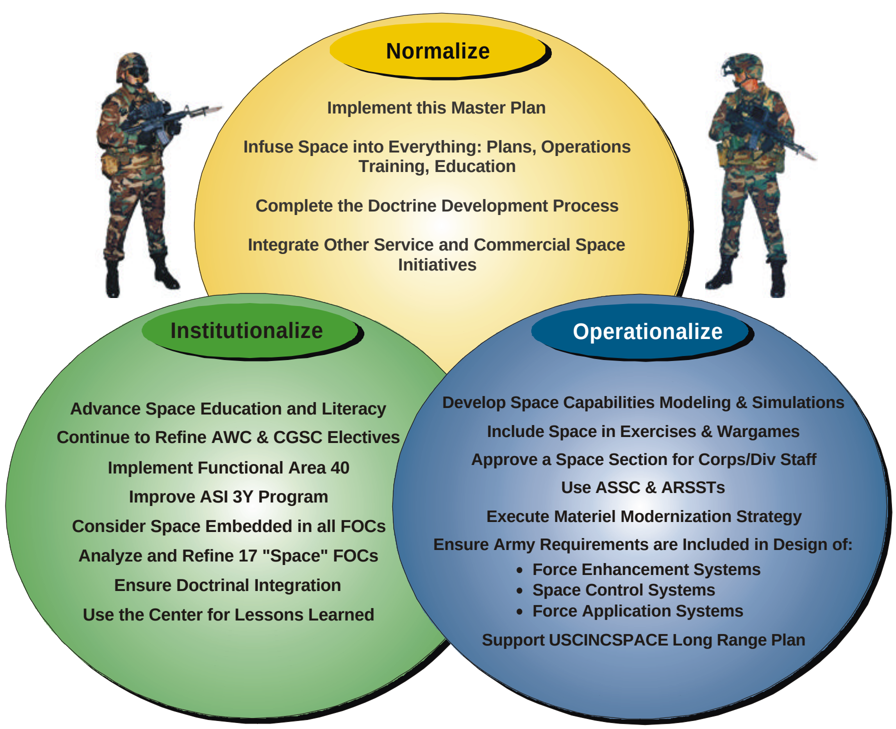
THE ARMY VISION AND SPACE

To adjust the condition of the Army to better meet the requirements of the next century, the Army's Vision forms an overarching goal to frame Army transformation initiatives. The Army Vision is articulated as follows: “Soldiers on point for the Nation transforming this, the most respected Army in the world, into a strategically responsive force that is dominant across the full spectrum of operations.” Realization of this vision will allow the Army to provide the Nation an array of deployable, agile, versatile, lethal, survivable, and sustainable formations, which are affordable and capable of reversing the conditions of human suffering rapidly and resolving conflicts decisively.

Space capabilities and products are essential to develop the specified attributes of our transforming Army. Strategic **responsiveness** is enhanced by the availability of space-based systems to provide an uninterrupted flow of information. Satellites will enable or provide surveillance capabilities, real time intelligence, global secure communications, position and navigation data, and the weather, terrain, and environmental data necessary to ensure a rapid and smooth flow of forces into the theater of operations, and thereby enhancing the Army's **deployability**. Situational awareness is maximized by the use of spaced-based systems and facilitates the mental and physical **agility** of the force. The ability of our organizational structures to generate formations that can dominate at any point on the spectrum of operations—that is, the force's **versatility**—is significantly enhanced by information made available by space-based systems. Assured communications, total situational awareness, and horizontal and vertical integration of effort, all garnered from space-based systems, are needed to coalesce the elements of **lethal** combat power. Space-based systems make possible the Intelligence Preparation of the Battlespace (IPB) necessary for the development and maintenance of force protection activities leading to force **survivability**. **Sustainability** of forces is completely dependent upon the uninterrupted flow of information. Increasingly that information is secured from space-based systems. Thus, the ability of the Army to realize its Vision of a strategically responsive force that is dominant across the full spectrum of operations is inextricably linked to the capabilities and products provided by space-based systems.

ARMY SPACE GOALS

The Army Space Master Plan serves to sharpen the Army's focus through the goals of *operationalizing*, *institutionalizing*, and *normalizing* space throughout the force structure. In order to do this, the Army must change the way in which space is viewed in day-to-day planning. While materiel solutions are crucial to affect change, they are only one factor in the overall effort to weave space into Army planning and operations. This plan supports the migration from a compartmented space capability to one that is fully institutionalized and operationalized. To achieve the end state of full spectrum dominance, it is imperative that the Army ingrains space into its way of life—i.e., normalize space.



Normalize

The Army must focus and shape its efforts to embed and use space in day-to-day operations and to fully integrate space into its institutions. Only by achieving operationalization and institutionalization of space can space become normalized—a part of the Army professional mindset. Just as leaders at all levels intuitively consider weather, intelligence, and fire support, they must integrate space capabilities and the space environment into every facet of training, exercises, and military operations. A constantly maturing, space literate force will identify new and refined requirements for support from space. These efforts will greatly enhance the normalization of space through the deliberate and conscious inclusion of space-based capabilities into the Army's entire planning, training, and operating spectrum.

Operationalize

Space-based systems and capabilities can provide near-real time relevant information directly to the warfighter to create situational awareness throughout the battlespace. Operationalizing space provides capabilities to rapidly task, process, exploit, disseminate, and display the information for the requesting commander. The Army will operationalize space by: determining requirements; conducting Army unique research, development, and acquisition; and shaping and leveraging the future design, architecture, capabilities and applications of joint, civil, and commercial space systems.

Of equal importance, operationalizing space requires continual education for commanders and soldiers on space systems' capabilities and limitations as well as integrating space support operations into exercises, training, and actual operations.

To completely operationalize space, Army leaders must continue to embed space capabilities and an understanding of their limitations in all they do. Planning, operations, and exercises must fully address space. It is essential that the Army invest in appropriate models and simulations of tactical space capabilities. The Army must thoroughly understand and effectively apply space in education, training, exercises, wargames, and operations.

Institutionalize

Space capabilities and knowledge of their limitations must be fully understood within all Army institutions. Throughout the entire professional military education and schooling spectrum, space education, literacy, and training must be a “vein” of knowledge in Army curricula—from officer pre-commissioning through the general officer CAPSTONE course, from enlisted basic training through the Sergeants Major Academy, and at all Department of the Army civilian levels.

Army college and school faculties must possess a high level of space knowledge, with the ability to apply, analyze, synthesize, and imbue that knowledge to their students. Since space capabilities affect all elements of the Army, there must be a conscious effort to ensure that space doctrine is integrated into all functional doctrine publications and that space is actively considered when preparing any overarching warfighting vision, concept, or "How to" manual.

In addition, personnel managers and board members who select and promote officers for the new Functional Area (FA) 40 Space Operations Officer designation and manage their career patterns must understand space. FA 40 officers must not only be space literate, but space "savvy". They must possess the aptitude to grasp space and multi-service, multi-agency procedures and be able to apply them to the tactical situation. Selected officers must have the basic branch operational background to be credible as members of corps and division battle staffs, and they must also be part of the Army Staff—recognized and accepted in the Pentagon and corporate Army.

SUPPORT TO KEY LEADERSHIP VISIONS

As demonstrated in the diagram below, the ASMP incorporates the over-arching space visions, goals, and objectives of the Chairman of the Joint Chiefs of Staff, the USCINCSPACE, the Chief of Staff of the Army, and national-level guidance into one comprehensive document.

Linkage to Joint Vision 2010

The ASMP goals support the operational concepts found in Joint Vision (JV) 2010. Those concepts—**dominant maneuver, precision engagement, full dimensional protection** and **focused logistics**–will be enhanced by the application of space capabilities and in some cases will be dependent upon them.

Space systems, including sensors, weapons, communications, and navigation, will enable the JV 2010 goal of full spectrum dominance by contributing significantly in all theaters of operations to the concepts of dominant maneuver, precision engagement, full dimensional protection, and focused logistics, as well as the evolving mission area of information operations. The Army will execute its joint responsibilities through a deliberate set of patterns of operation, derived from JV 2010, which serve to focus the tasks the Army must accomplish to be successful: Protect the Force, Decisive Operations, Shape the Battlespace, Project the Force, Sustain the Force, and Gain Information Dominance.

Space capabilities enable dominant maneuver by adding operational and strategic height/depth to maneuvering forces, providing information and communications unimpeded by terrain restrictions, and enabling precision navigation fires.

Linkage to the Army Vision

The ASMP supports the Army's goals of achieving both strategic responsiveness and full spectrum dominance as the land component member of the joint team. Army elements will execute their responsibilities by providing the nation with an array of deployable, agile, versatile, lethal, survivable, and sustainable formations which are affordable and capable of reversing the conditions of human suffering and resolving conflicts decisively. Perhaps no other force enabler can facilitate the Army making its objectives as much as space. Space abilities in support of critical deployment, operational, and sustainment functions make the transformation of the Army possible.

Space systems provide an accurate and reliable means of precision engagement by providing situational awareness and precise navigation and by sending targeting information to weapons platforms and, in the future, in-flight munitions.

Linkage to U.S. Space Command Vision 2020

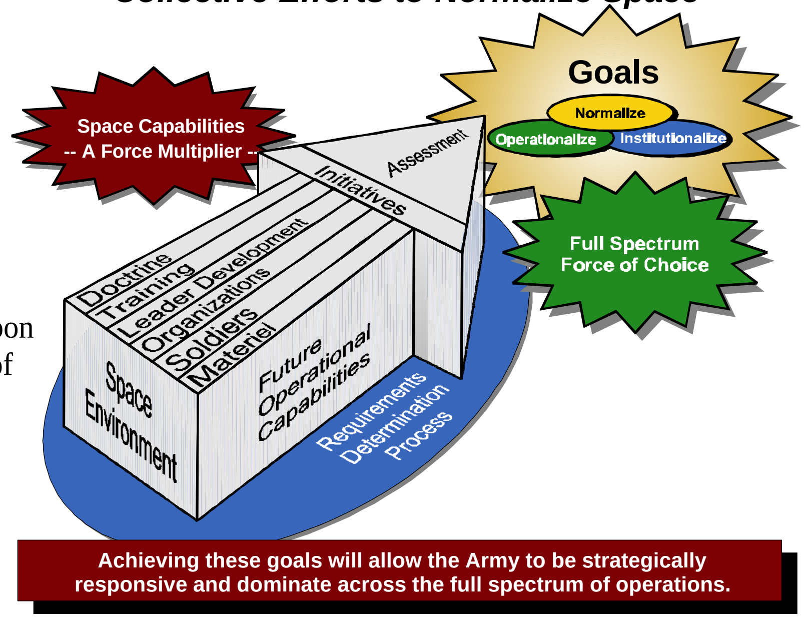
The two principal themes of the U.S. Space Command (USSPACECOM) Vision are **Dominating the Space Medium** and **Integrating Space Power** throughout military operations. The USSPACECOM Long Range Plan (LRP) implements USSPACECOM Vision 2020. To attain the vision, USSPACECOM has created four operational concepts. These operational concepts provide the conceptual framework to transform the vision into capabilities: Control of Space, Global Engagement, Full Force Integration, and Global Partnerships.

As the Army proceeds to achieve its space goals within existing frameworks, all space assets and capabilities must be congruent and interwoven with USSPACECOM Vision 2020.

ASMP METHODOLOGY

The methodology used to develop the ASMP began with the visions of the Chairman of the Joint Chiefs of Staff, the USCINCSPACE, the Chief of Staff of the Army, and related documents providing a foundation for direction. The Space Environment and Army Requirements Determination Process were then assessed, resulting in a focus on Future Operational Capabilities (FOCs) which were analyzed, reviewed, then dissected into three areas: Non-Materiel Activities, Current Systems and Modernization Strategy, and Army Space Initiatives. The seventeen Space FOCs were then analyzed and assessed. Based upon this methodology of analysis and assessment, the ASMP outlines conclusions and challenges for the future of space in the Army.

The ASMP Shapes and Focuses the Army's Collective Efforts to Normalize Space



Space forces enable full dimensional protection by providing missile attack warning and control of the space portion of the battlespace.

Space Environment - Now and Future

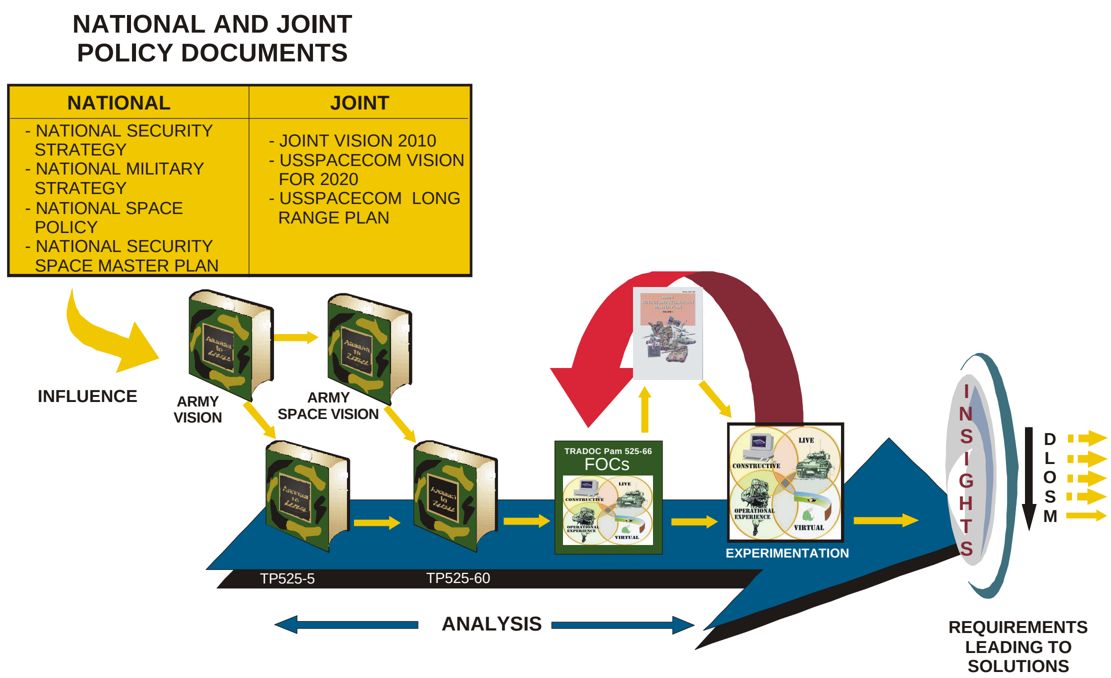
The ASMP begins by defining the "space environment." The environment, however, should not be confused with the medium of space. Rather, it is the body of policies, plans, organizations, agencies, and global threats that influence, enhance, and enable the space missions, warfighting concepts, programs, initiatives, and experiments described in later chapters. The ASMP reviews three documents that chart the azimuth for future space activities and programs: *the National Space Policy, the National Security Space Master Plan*, and *the United States Space Command Long Range Plan*. This is followed by a review of the expanding space community and includes a discussion of the evolving trends in the national security, civil, and commercial space sectors. Finally, the space environment review provides a dual-perspective of the space threat, first from the viewpoint of man-made threats to space systems, and then from the perspective of threats posed by space systems to ground forces. Included in the threat discussion is a review of the global threat environment in which Army space initiatives, concepts, and programs will operate.

Space systems will form a critical part of the logistics-tracking infrastructure necessary to achieve focused logistics.

Army Space Requirements Determination Process

With an understanding of the space environment, the ASMP reviews how space requirements are determined, documented, and processed. It addresses the Space Requirements Determination Process managed by SMDC in coordination with TRADOC branch proponents. The ASMP specifically addresses:

- Space requirements coordination and integration procedures detailed in the TRADOC and SMDC Memorandum of Agreement signed in February 1997.
- The Army's role in joint requirements determination.
- National and Joint policy documents that impact on space requirements determination.
- The Army Space Requirements Determination Process detailed in SMDC's Draft Handbook for Requirements Determination.
- The status of documents and activities that currently affect the generation of space requirements with emphasis on the space warfighting concept and the FOCs derived from that concept.



Non-Materiel Activities

The Army will make a quantum leap in the operationalization, institutionalization, and normalization of space in the near term through the synchronization and emphasis on the non-materiel means to improve readiness. The ASMP addresses the three pillars that form the foundation to institutionalize a space mindset in the immediate future: 1) leader development, training, and education, 2) embedding a special staff section at corps level and investigating the need at division-level and below, and 3) documented space integration across the spectrum of cornerstone documents and publications. This must be achieved by the focused integration of space throughout the Army's colleges, schools and centers, and unit training.

Current Systems and Modernization Strategy

The ASMP next provides an overview of space systems and their related ground segments of most interest to the Army out to the year 2005, with extrapolation out to the year 2020. The modernization strategy is driven by improving on past capabilities while preparing for the enhancements to be ushered in with the first digital division in 2000 and the first digital corps in 2004. With sufficient capacity in space and on the ground, space capabilities and products will allow Army commanders and units to gain and maintain information superiority and full spectrum dominance.

The Army's requirements for space capabilities are expected to exponentially increase during the next two decades. The promise of continued digitization and information superiority is highly dependent on assured access to adequate space and related ground assets and seamless integration with complementary capabilities. The strategies for modernizing individual systems represent a bridge to realizing the Army of 2010.

Army Space Initiatives

The ASMP defines the space initiatives (technology developments, experiments and demonstrations) that are designed to satisfy the Army's space FOCs as contained in TRADOC Pamphlet 525-66 (FY98 Draft). These initiatives also support the Army's concept of operations as articulated in TRADOC Pamphlet 525-5, TRADOC Pamphlet 525-60, and the current modernization strategy.

The Transforming Army		Space Enablers
Project the Force	Deployable	• Global Broadcast Networking • En Route Battle Command and Mission Rehearsal • Battle Command on the Move • Lethality at Extended Ranges • Precision Systems and Munitions • Sensor-to-Shooters Links • Multidimensional Joint Air and Missile Defense • Near Real Time Intelligence • Speed, Agility, and Long Range Weapons • Total Asset Visibility • Movement Tracking System • Global Command and Control System • Linked Strategic, Operational, and Tactical Sensors and C4I • Smart Jamming
Decisive Operations	Agile	
Shape the Battlespace	Versatile	
Protect the Force	Lethal	
	Responsive	
Sustain the Force	Survivable	
Information Dominance	Sustainable	

Capabilities Assessment

The ASMP presents an overall assessment of the Army's existing and planned capabilities and initiatives in space mission areas. This assessment provides the basis for identifying shortfalls and making future investment decisions.

The assessments in the ASMP rate the projected Army space capability to meet the FOC challenges for the near-term (FY00-04), the mid-term (FY05-10), and for the far-term (FY11-25). Capabilities are rated against the operational requirements for each time period. From the force enhancement perspective, the FOC process is on-track and attacking the capability combat multipliers. However, in those capability areas traditionally supported by other Services, Army space initiatives are lacking.

Overall Assessment - Non-Materiel

In the non-materiel (DTLOS) domain it is apparent that organizational, doctrinal, and leader development road maps are in place to offset existing shortfalls. The overall assessment for DTLOS in 2005 is Green. Shortfalls in the non-materiel domains are currently being systematically addressed. Solutions now in conceptual form will be executed within the short-term. Internal and external commitments of resources (people, time, and funds) will be required to complete the tasks necessary to normalize and institutionalize space. A key factor to DTLOS success in this time frame was the designation of SMDC as the specified proponent for space. This action supported a consolidated and integrated approach to solving space issues.

Overall Assessment - Materiel

The preponderance of DTLOS solutions and activity fall within the short-term. Materiel solutions, on the other hand, extend to the out-years. Consequently, the assessments for the “M” in DTLOMS reflect ratings for near-term, and also mid- and far-term. Adequacy of materiel solutions are assessed by the mission areas identified below:

- Communications
- Intelligence, Surveillance, and Reconnaissance (ISR)
- Weather, Terrain, and Environmental Monitoring (WTEM)
- Position, Navigation, and Timing
- Missile Warning
- Space Control

The overall assessment for the Materiel portion of DTLOMS is Amber. The overriding criteria for the Amber assessment are the projected abilities to maintain overmatch and to execute the modernization strategy. Because of resource constraints, materiel limitations are more significant than those in the DTLOS domains. Solutions to warfighter space materiel activities are therefore more problematic. To optimize future investments, the Army must derive and quantify specific warfighter requirements. This process will require new initiatives, reprogramming of existing or planned programs, and cancellation of others. A purposeful and well-executed plan is required to attain a Green rating.

CONCLUSIONS

The ASMP reviewed the senior leader visions, the space environment, the TRADOC requirements processes, and DTLOMS actions, then developed a current assessment by space FOC. That assessment, coupled with the plan's primary goal to shape and focus Army leadership and staff at all levels, charts a deliberate course for the Army to normalize space technologies and capabilities and achieve full spectrum dominance.

This detailed review of the Army's involvement in space activities concludes that “space” in the Army remains focused on vertical developments and is not benefiting from horizontal integration. In addition, although elements of space-related missions exist in most organizations and agencies, to a large degree they are specialized, of lesser importance, and often secondary if not tertiary duties. In light of the Army's recognized importance and reliance on space-based capabilities, this plan supports the migration from a compartmented space capability to one that is fully institutionalized and operationalized.

Actions to be Taken

The war colleges and staff colleges are prime examples of opportunities for the Army to institutionalize the appreciation of space capabilities throughout the officer corps. Additional and challenging space electives, capturing leading edge technologies and their applications to the warfighter, must be developed and offered. The opportunity to improve space literacy within the Army should occur at every level of the military education system—from basic training initiation tasks to War College research papers.

The concept of a special staff section for space at corps, divisions, and separate brigades has the potential to revolutionize the manner in which space is integrated into planning, readiness, and operations. The FA 40 must spearhead the effort to integrate space into corps and division staffs.

Since space capabilities affect all elements of the Army, there must be a conscious effort to ensure that space doctrine is integrated into all the functional doctrine publications. To completely operationalize space, Army leaders must continue to embed space capabilities and an understanding of their limitations in all they do. Planning, operations, and exercises must fully address space.

The Army's near-term space modernization actions focus on procuring the proper mix of ground segment terminals. The Army must execute the modernization strategy defined in the Space Annex of the Army Modernization Plan.

As the Army evolves on the path to modernization, it must recognize that space is a major element in the equation of change. The Army Space Master Plan is the next step towards attaining the operationalization, institutionalization, and normalization of space for the warfighter and implementing a coherent Army space strategy to support the future Army. It is a serious and necessary attempt by the Army to integrate and synchronize Army space support for the land warrior. Future iterations of the Army Space Master Plan will expand upon this effort, to include specific strategies and timelines to address operational concepts and the space mission areas. The long-term intent is to shape and influence decision-making processes and science and technology development within the DoD, other agencies, industry, and academia and to ultimately develop an interoperable set of space and terrestrial architectures to achieve full spectrum dominance.

Challenges

A major challenge confronting future ASMPs is the incorporation and delineation of a detailed space programming and budgeting timeline in order to prioritize and quantify actual resources in one place. This integration into the Planning, Programming, and Budgeting System (PPBS) process is critical to ensure that space capabilities are fielded and supporting the force.

Part of this PPBS process impacts space technologies. These technologies and their applications may be revolutionary as well as evolutionary in nature, and their applicability and introduction into the force must be carefully managed and controlled. From a technological perspective, space initiatives can cover the whole gamut of concepts, experiments, and demonstrations. Modeling and simulation advancements must be incorporated into these initiatives. In many cases, some of these initiatives have some duplication and/or overlap. In this era of constrained funding, it is imperative that a cohesive and integrated approach be taken in maximizing the Army's return on investment for space.

The role of information operations (IO) must also be examined and integrated into the ASMP. IO and space are clearly linked, and the challenge that is confronting the community as a whole is clearly defining their relationships and then developing and implementing the correct processes and courses of action.

Future Iterations of the ASMP

Future iterations of the Army Space Master Plan will expand and more precisely define the broad direction stated in this master plan. The next ASMP must provide more specific milestones and more detailed timelines, coupled with the identification of organizations and/or agencies that have proponency for each area.

With space increasingly impacting so many elements of the Army, subsequent ASMPs will require significant involvement and commitment from the Army community. The coordination and efforts in generating the next ASMP must be expanded to include all materiel and combat developers, as well as warfighting organizations and units. One element in this process, particularly with regard to DTLOMS solutions, will be the TRADOC-sponsored Tier 1 Space Integrated Concept Team (ICT). Working groups within the Space ICT will provide input during the development of updates to the ASMP.

The Army space requirements process must be better addressed in the next ASMP. All FOCs that relate to space need to be included in follow-on assessments. The next ASMP must also include how the Army will take advantage of other services and commercial efforts in space. Last, the next plan must meet the challenge of better linking the Army's space requirements to the U.S. Space Command Long Range Plan and USCINCSPACE's Integrated Priority List.

"We have some challenges ahead: balancing progressive innovation with ongoing support to today's missions; orchestrating broad based multi-organization efforts; developing technically and professionally; inter-operating resources effectively. We have a lot to do, but it is well within our talents. Our success will make a difference to the Nation—now, tomorrow, and into the future."

— USASMDC Vision
October 1, 1997

SUMMARY

The ability to access and use space is a recognized vital national interest, and space is increasingly critical to U.S. military, civil, and commercial activities. Integrating space capabilities and applications into all aspects of U.S. military training, operations, and contingency plans is essential to realizing the full capabilities of space as a strategic enabler.

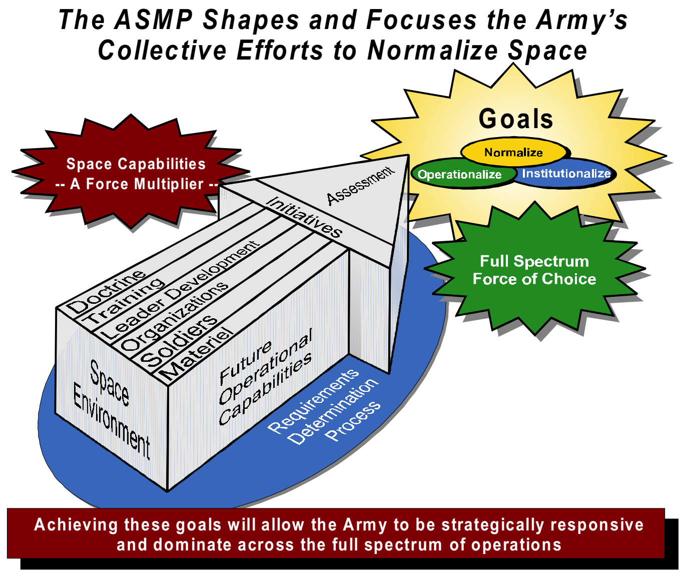
The widening role that space plays in tactical operations demands a coherent, focused, and workable plan to maximize the land force's advantage. This ASMP is the Army's effort to state where space plays in the battlefield equation. This is a dynamic plan that will benefit from informed discussion and innovative dialogue throughout the Army Space Community.

Based upon the visions of the CJCS, CSA, and USCINCSPACE, senior leaders throughout the Army must encourage and elicit space integration in all aspects of Army operations. Focused on FOCs, the TRADOC processes must be followed in order to achieve the desired goals of operationalizing, institutionalizing, and normalizing space leading to the end state of full spectrum dominance.

The combined effects of the current strategic pause, the evolving space and information age, and the likelihood of a revolution in military affairs enabled by space capabilities indicate that the time is right to have an integrated master plan for space. This plan charts a course to support the country's full spectrum force of choice by achieving desired warfighting capabilities, CONOPS, and organizations necessary to protect U.S. national interests, reverse the conditions of human suffering, deter war, and, if necessary, fight and win our nation's battles.

JOHN COSTELLO
Lieutenant General, USA
CG, USA SMDC

Chapter 1: Introduction



Purpose

This Army Space Master Plan (ASMP) provides the overall direction and guidance necessary to implement the Army space policy. The ASMP will focus Army leadership and staff at all levels and shape their efforts to operationalize, institutionalize, and normalize the benefits that space capabilities bring to the Army. The emerging synergy of space, land, sea, and air superiority will enable the Army to "dominate the full range of military operations from humanitarian assistance through peace operations, up to and into the highest intensity conflict" thus achieving dominance across the full spectrum of operations. [Joint Vision 2010]

Space capabilities permeate virtually every Army mission area. Therefore, the means available to fully normalize space requires attention and effort from every Army command, center and institution. As we develop a full appreciation of the benefits of space, we will make evolutionary progress in meeting its dynamic challenges. Every facet of doctrinal and materiel change must be analyzed, pursued, and integrated. This process will ensure information dominance and overmatch capabilities to conduct decisive operations across the spectrum in the 21st Century.

"...Space is the high ground in the 21st Century, we understand that. We (the Army) are very dependent on space... and so our effort has been to increase emphasis in terms of Army involvement in space."

GEN Reimer, former Chief of Staff of the Army, May 20, 1998

The means to normalize space run the gamut from maneuver commanders training, exercising, and stating needs, to college and school faculty members researching ideas, to concepts and doctrine writers across the Army producing new thoughts. Space must be embedded in the way we do business, not unlike the seven battlefield operating systems: Maneuver, Fire Support, Intelligence, Air Defense, Mobility/Counter Mobility, Command and Control, and Combat Service Support.

The Army's focus and emphasis on digitization will permit deployed forces to overwhelm adversaries by operating within a quicker decision cycle and by reducing fog and friction. Digitization is enabled by interoperable space capabilities and applications.

Space is no longer the frontier battleground of some future time frame. It is a medium vital to successful Army operations around the globe, and is recognized as the fourth dimension of warfare (i.e., land, sea, air, and space) through and from which Army operations may be affected globally now and into the future. Access to and the availability of space capabilities, as well as awareness of their limitations, are critical to the achievement of enhanced performance across the full spectrum of Army operations.

Digital linkage via orbiting satellites already enhances situational awareness, force protection, and precision firing solutions for the execution of deep fires and maneuver of forces on the modern battlefield. The medium of space and space products are increasingly a critical consideration for leaders and planners at all levels. As the Army evolves into a 21st Century warfighting force, soldiers must be trained to understand the potential benefits of combat multipliers derived from space assets and to use them effectively. Space capabilities will significantly augment terrestrial capabilities to achieve dominance across the full spectrum of operations.

Unfortunately, too often in the past the Army has assumed the availability of space capabilities without fully defining and shaping space capabilities and applications essential to its warfighting role. This plan—fully integrated within the Army's modernization strategy—shapes the Army's normalization of space operations to ensure that future space capabilities are designed to benefit the warfighter.

Inherent throughout this plan is the need for the Army to continuously shape and leverage systems and technologies that the other Services and national security, civil or commercial agencies are undertaking. Active involvement is required in the joint arena to ensure that Army requirements are accurately and adequately portrayed so that the Army can: 1) avoid costly stovepipe programs; and 2) leverage and integrate needed capabilities into the Army force structure. Accomplishing this requires the Army to have a well-trained and dedicated cadre

of innovative and space-literate people who must understand the warfighting requirements of the Army and can effectively articulate these requirements within the Army and Joint arenas. They must also understand the programs that the other services and agencies are pursuing in order to identify potential shaping and leveraging opportunities.

Background

This document is the second ASMP. The first was published in 1987 under the direction of then Vice Chief Staff of the Army (VCSA), GEN Maxwell Thurman. These Army goals directed the Army to achieve successes in several areas. The current plan builds on the foundation of the 1987 plan and looks to move the Army forward in space.

1987 Goals	Status
Space Expertise Posture the Army for operations in the space age with a cadre of space expertise and widespread understanding of space throughout the operational commands.	• Creation of USARSPACE to assist ground commanders to exploit space capabilities. • The designation of Additional Skill Identifier (ASI) 3Y, Space Activities, was an interim solution to meet initial Army needs in space expertise. • A new initiative, OPMS XXI, and FA 40, Space Operations, should provide the needed emphasis to correct this deficiency by distributing educated, space-literate personnel throughout the Army. • Space education and training within the Army educational institutions and training system has met moderate success but lacks a cohesive directional plan.
National Space Community Support Exploit current space capabilities by influencing the National Space Community to provide support throughout joint space systems.	• The National Space Community supports the tactical warfighter with information derived from the full, diverse, and redundant array of national systems and associated processors as well as the TENCAP systems of the Services. • A reluctance remains to fully support additional direct downlink (DDL) concepts.
Combat Development Process Develop additional space related capabilities by expanding the combat development process to include space assets.	• The innovative application of space capabilities has not become a mainstream combat development process within the Army. • Creation of the Space and Missile Defense Command (SMDC) Force Development and Integration Center (FDIC) and incorporation of the FDIC into the rest of the combat development community will assist in correcting this shortcoming by adding additional unique expertise.

Table 1-1: 1987 ASMP Goals

Space Goals

This plan is designed to shape the Army's attention on the importance of space capabilities through the goals of *operationalizing*, *institutionalizing*, and *normalizing* space. These goals will focus the Army's collective efforts to achieve *full spectrum dominance*.

The Army must change the way in which it views space. Materiel solutions are crucial, however they are only one factor in the overall holistic effort to weave all DTLOMS areas together. The realization of the end state will only happen through concurrent, continuous efforts by all leaders to ingrain space capabilities and operations throughout our forces, operations, and institutions.

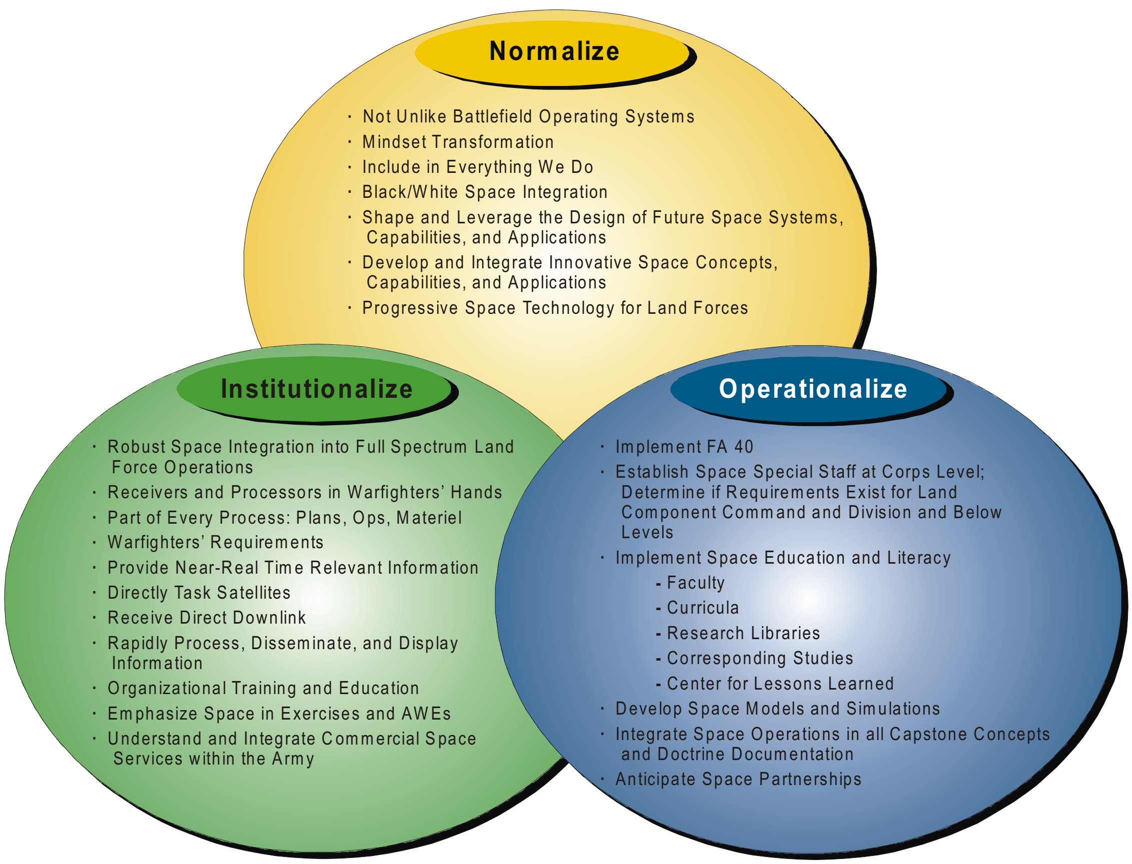


Figure 1-1: Army Space Goals

Normalizing Space

Only by achieving operationalization and institutionalization of space can space become a part of the Army professional mindset. Just as leaders at all levels intuitively consider weather, intelligence, and fire support, etc., they must integrate space capabilities and the space environment into every facet of training, exercises and military operations. A constantly maturing, space-literate force will identify new and refined space requirements.

Operationalizing Space

General Estes, U.S. Air Force (USAF), coined the term "operationalizing space" when he was the Joint Staff J3 and further refined and implemented the concept as Commander in Chief United States Space Command (USCINCSPACE). The Army not only embraces his vision, but deems it imperative to implement the Army Vision.

To achieve Army XXI and harness the power of information, the Army must now begin to operationalize space for the warfighter. Operationalizing space begins with the warfighter's requirement to conduct decisive operations and achieve full spectrum dominance. Space-based systems and capabilities provide near to real time relevant information directly to the warfighter to create situational knowledge throughout the battlespace. Operationalizing space includes supporting the ground commander by providing the means and methods to directly task a constellation of satellites and to receive the information through direct downlinks. Operationalizing space provides capabilities to rapidly process, disseminate and display the information to the requesting commander.

The Army will operationalize space by determining requirements, conducting Army unique research, development and acquisition, and shaping and leveraging the future design, architecture, capabilities and applications of joint, civil, and commercial space systems. Of equal importance, operationalizing space means educating commanders and soldiers on space systems, capabilities, limitations, and integrating space operations into exercises, training, and actual operations.

Institutionalizing Space

Knowledge of space capabilities and their limitations must be fully embedded within all Army institutions. Throughout the entire professional military education and schooling system—from officer pre-commissioning through the general officer CAPSTONE course, from enlisted basic training through the Sergeants Major Academy, and at all DA civilian levels—space education, literacy (SEL), and training must be a "vein" of knowledge in Army curricula.

Army college and school faculties must possess a high cognitive level of space knowledge, with the ability to apply, analyze, synthesize, and imbue that knowledge to their students. Efforts to develop and implement the joint SEL program must be continued and supported. Research libraries must contain the appropriate space literature to promote the development of innovative space concepts and white papers to stimulate academic discussions. The Center for Army Lessons Learned (CALL) must capture space lessons. Models and simulation efforts must accurately replicate space systems, capabilities and limitations.

Personnel managers and board members who select and promote officers for FA 40 and manage their career patterns must understand space. They must carefully choose officers who possess the aptitude to grasp space and multi-service, multi-agency procedures. Selected officers must also have the operational background to be credible as members of corps and division battle staffs.

Doctrinally, space must be actively considered when preparing any overarching warfighting vision, concept, or "How to" manual that is published.

Army Need for Space

Space is the high ground today and will be in the future. Space systems are critical enablers to achieving information dominance and ensuring full spectrum dominance across all levels of conflict. The Army will not be able to execute its future concepts and doctrine without space capabilities.

Space is an operating environment that is distinct from land, air, and sea domains. Space-based assets transcend geographical borders unimpeded. Since there are no recognized political boundaries in space, satellites enjoy "open skies" global coverage. Depending upon redundancies and mix of payloads, satellites can operate day/night and in all weather. The space environment envelops all other mediums thereby creating the ultimate high ground for military operations. The Army's challenge is to determine how to effectively integrate space systems and capabilities into military operations. This need to orchestrate space assets and space operations requires a paradigm shift in the way the Army thinks about space, space operations and even space warfare.

Prior to 1987, the Army considered space in the context of tasks associated with strategic communications, intelligence, and missile warning supporting the National Command Authorities. The Army developed one-of-a-kind solutions to support its unique battlefield functions and operations. Space was not viewed as a significant combat multiplier but more as a limited capability assisting Army forces in conducting intra-theater point-to-point communications and providing intelligence classified to a level restricting information from many commanders.

Desert Storm changed this perspective. Space systems provided the communications infrastructure to command and control mobile armor formations and to synchronize precision strikes. The Global Positioning System (GPS) allowed precision navigation and strikes across the featureless Arabian peninsula, and the Defense Support Program (DSP) warned the Army's forward deployed forces of imminent ballistic missile attacks from Iraqi SCUD launches.

With the advent of digitization, information dominance, contemporary patterns of operation derived from JV 2010 and Army force descriptors, and the proliferation of commercial space systems, space-based assets are evolving as integral operating capabilities by providing relevant and time-sensitive information directly to the warfighter. Our growing dependence upon space capabilities is recognized by our adversaries and could eventually be at risk. The control and protection of national security, civil, and commercial space systems will become paramount to achieving full spectrum dominance now and in the 21st Century.

Current and future Army operations are time sensitive and complex. Commanders require relevant and timely information to conduct rapid and decisive operations. The Army is addressing this complex environment by transforming into a capabilities-based and threat adaptive force. The goal of this force is to link the seven battlefield operating systems into a command and control, sensor, and weapon systems network, which will integrate and orchestrate effects within the joint battlespace.

Space Support to Key Visions

The ASMP incorporates the over-arching visions, goals, and objectives of the CJCS, USCINCSPACE, CSA, and national-level guidance into one comprehensive document (Figure 1-2).

Linkage to Joint Vision 2010

The Army Space Policy and the goals described in this ASMP support the operational concepts developed in Joint Vision (JV) 2010. Those concepts—dominant maneuver, precision engagement, full dimensional protection and focused logistics—will not only be enhanced by the application of space capabilities but in some cases will be dependent upon them.

Space capabilities will enable **dominant maneuver** by adding operational and strategic height/depth to maneuvering forces, providing information and communications unimpeded by terrain restrictions, and enabling precision navigation and fires. Military communications flowing in and through space will allow forces at dispersed locations to synchronize operations and to mass effects without massing forces.

Figure 1-2: ASMP Synthesis of Space Visions and Guidance

Dominant maneuver for the Army translates into the ability to project the force at the strategic level and to conduct decisive operations at the operational level. Total asset visibility (TAV) and global broadcast services, two key enablers of the Army's ability to rapidly project the force, are conducted in and through space. TAV, or the ability to track the location of supplies, personnel and equipment worldwide in all stages or phases of deployment, will depend upon a network of space-based sensors and communications systems to be effective.

The positioning of key components of the TAV infrastructure in space is the most reliable, efficient, and cost effective means of achieving this capability.

Space systems provide an accurate and reliable means of **precision engagement**, not only by providing situational awareness and precise navigation, but also by sending targeting information to weapons platforms and, in the future, in-flight munitions. Space systems, with their world-wide coverage and generally unencumbered view of the theater of operations, are uniquely suited to providing U.S. Army forces with accurate and timely targeting information. Furthermore, space weapons might take advantage of targeting information collected by and/or moving through space systems to pinpoint strategic, operational, and tactical targets while minimizing collateral damage. The reduction of collateral effects will enable U.S. forces and policy makers to avoid the adverse political ramifications associated with unnecessary or unavoidable civilian casualties.

At present, the notion of weapons in space is not consistent with U.S. national policy. However, planning for that possibility is important, should the civilian leadership decide that the application of force from space is in the national interest. Space-based weapons systems could engage cross-dimensionally, attacking forces in space, in the air, at sea, and on land and protecting U.S. forces in these areas as well.

Space forces will enable **full dimensional protection** by providing control of the space portion of the battlespace. Space systems will conduct surveillance and targeting of threat space systems, to include ground control facilities. Space forces will achieve space superiority by the judicious application of force, threat of force, and application of various denial strategies, including information operations. Furthermore, robust and redundant space systems, including a shared commercial, civil, and national security space infrastructure, will mitigate the effects of threat attacks on space forces. The capability of missile launch detection from space is one of the bedrock capabilities space brings to the battlefield. Current capabilities will be greatly improved by new systems now under development.

Space systems will form a critical part of the logistics-tracking infrastructure necessary to achieve **focused logistics**. The Joint logistics vision describes the need for information superiority—the ability to collect, process, and disseminate information. Similar to the Army's tenet of distribution based logistics, focused logistics seeks to merge information and logistics so that the Army can rapidly respond, track, and reallocate assets and provide time definite delivery of assets. The Army’s Revolution in Military Logistics (RML) vision underscores the requirement for real-time situational awareness: visibility of assets, resources, infrastructure, and information flow. The distribution manager must know what assets he has to support, what supported units need, and what means he has at his disposal to get those assets to the needing unit.

Space systems, including sensors, weapons, communications and navigation will enable the JV 2010 goal of **full spectrum dominance** by contributing significantly to the operational concepts of dominant maneuver, precision engagement, full dimensional protection and focused logistics, as well as the evolving mission area of information operations.

The Army Vision and Space

To adjust the condition of the Army to better meet the requirements of the next century, the Army's Vision forms an overarching goal to frame Army transformation initiatives. The Army Vision is articulated as follows: "Soldiers on point for the nation transforming this, the most respected Army in the world, into a strategically responsive force that is dominant across the full spectrum of operations." Realization of this vision will allow the Army to provide the nation with an array of deployable, agile, versatile, lethal, survivable, and sustainable formations, which are affordable and capable of reversing the conditions of human suffering rapidly and resolving conflicts decisively.

To facilitate achieving this vision, the Army's force modernization and investment strategy is adapting plans, programs, and strategies to organize and equip an Army that:

- is capabilities-based, threat adaptive, and postured to support the nation's military requirement:
- remains the dominant land force and has the agility, versatility, and capability to transition rapidly from one point on the full spectrum of operations to another with the least loss of momentum; and
- is efficiently and economically modernized to provide the best value to the American people.

The Army's intent is to transform from a post-Cold War construct to a land force that is positioned for contemporary and future missions in the fullest range of the spectrum of conflict. The desired end state is a strategically responsive Army capable of early entry and joint operations, but not dependent upon fixed forward bases.

It is an Army capable of efficient and dominant operations along the full spectrum of military operations. It has a common organizational design that facilitates flexibility, sustainability, agility, and deployment while minimizing the logistics tail associated with combat support and combat service support tasks. It is a lethal and dominant Army, which is interoperable and capable of sustained, relentless combat.

The Army's goals are to deploy a combat capable brigade anywhere in the world in 96 hours, a combat capable division on the ground anywhere in the world in 120 hours, and five divisions on the ground anywhere in the world in 30 days. To accomplish these goals, the Army's transformation must rely upon a force design that is lighter and more agile than the current construct's heavy forces, but more lethal, survivable, and tactically mobile than the current construct's light forces. As this force is presently in design, its construct and initial equipment set cannot be described with any certainty, but the descriptors of this transformed Army clearly indicate a robust role for space-based systems as enabling operations and technologies. The transformed construct and equipment selection will also drive changes to doctrine, tactics, techniques, and procedures, which could enable greater reliance on space-based assets at a more tactical level of operations.

Descriptors of the Transformed Army
• A strategically responsive force that is dominant across the full spectrum of operations: maximizing our deterrent effect and diminishing challengers' opportunities • An interoperable force designed for early entry, full spectrum operations • Lethal, survivable, and sustainable while engaged in ruthless combat • Dominant across the full spectrum of operations with agility and versatility that allows rapid transition along point on the spectrum of operations without loss of momentum • Logistically efficient • Reliant upon reach back capabilities • Reliant upon reduced replenishment demand • Commonality among platform, chassis, caliber, component, and branch • Relentless combat power and survivability at less weight and bulk • Leader of or efficient support to Joint and combined operations • Able to deploy a combat capable brigade anywhere in the world in 96 hours, a combat capable division on the ground anywhere in the world in 120 hours, and five divisions on the ground anywhere in the world in 30 days

Table 1-2: Descriptors of the Transformed Army

Space capabilities and products are essential to develop the specified attributes of our transforming Army. Strategic **responsiveness** is enhanced by the availability of space-based systems to provide an uninterrupted flow of information. Satellites will enable or provide surveillance capabilities, real time intelligence, global secure communications, position and navigation data, and the weather, terrain, and environmental data necessary to ensure a rapid and smooth flow of forces into the theater of operations, thereby enhancing the Army's **deployability**. Situational awareness is maximized by the use of space-based systems and facilitates the mental and physical **agility** of the force. The ability of our organizational structures to generate formations that can dominate at any point on the spectrum of operations—that is, the force's **versatility**—is significantly enhanced by information made available by space-based systems. Assured communications, total situational awareness, and horizontal and vertical integration of effort, all garnered from space-based systems, are needed to coalesce the elements of **lethal** combat power. Space-based systems make possible the Intelligence Preparation of the Battlespace (IPB) necessary for the development and maintenance of force protection activities leading to force **survivability**. **Sustainability** of forces is completely dependent upon the uninterrupted flow of information. Increasingly that information is secured from space-based systems. Thus, the ability of the Army to realize its Vision of a strategically responsive force that is dominant across the full spectrum of operations is inextricably linked to the capabilities and products provided by space-based systems.

Linkage to Army Operations

The goal of the Army Vision is to transform the Army "into a strategically responsive force that is dominant across the full spectrum of operations." Army elements will execute their joint responsibilities through a deliberate set of patterns of operation, derived from JV 2010, which serve to focus the tasks the Army must accomplish to be successful. The patterns are: Project the Force, Decisive Operations, Shape the

Battlespace, Protect the Force, and Sustain the Force. Five of these patterns align precisely with the JV 2010 operational concepts mentioned earlier. The sixth, Gain Information Dominance, is fundamental to each of the others.

The current Army Vision and subsequent decisions by the Army have initiated actions to transform the entire Army over time in order to better serve the nation. The transformation will result in an Objective Force capable of rapidly responding to a full spectrum of operations. It will have a core capability for major theater of war combat, yet be prepared for rapid response, mission tailoring, and the complexity of contingency operations. Descriptors of the Objective Force are many, but key elements include deployability, agility, versatility, survivability, sustainability, and responsiveness. There are others, but they are all designed to facilitate a transformation of the Army that is relevant to future missions and that provides the flexibility, responsiveness, and combat power needed.

The Transforming Army		Space Enablers
Project the Force	*Deployable*	• Global Broadcast Networking • En Route Battle Command and Mission Rehearsal • Battle Command on the Move • Lethality at Extended Ranges • Precision Systems and Munitions • Sensor-to-Shooter Links • Multidimensional Joint Air and Missile Defense • Near Real Time Intelligence • Speed, Agility, and Long Range Weapons • Total Asset Visibility • Movement Tracking System • Global Command and Control System • Linked Strategic, Operational, and Tactical Sensors and C4I • Smart Jamming
Decisive Operations	*Agile*	
Shape the Battlespace	*Versatile*	
Protect the Force	*Lethal*	
	Responsive	
Sustain the Force	*Survivable*	
Information Dominance	*Sustainable*	

Table 1-3: Space Enablers for the Transforming Army

Deployable

In the future, within hours of a political decision, Army forces will deploy to the battlespace on Air Force, Navy, and commercial transports as soon as U.S. forces have achieved freedom of action in space and along the air and sea lines of communication.

Space capabilities enhance the Army's ability to secure ground lines of communication. This is reinforced through the control of space, force application, and force enhancement capabilities. During deployment, commanders will focus on the successful movement of their organizations and equipment, the tactical situation and battlespace awareness, and refinement of plans and tactical rehearsals. Commanders at higher echelons will be able to watch multiple areas of interest as missions develop.

Agile, Versatile, Lethal

The future campaign will be prosecuted with a series of synchronized blows. When the battlespace has been shaped satisfactorily, the force commander will mass effects by initiating decisive operations directed against the enemy's centers of gravity. Over time, they will cause the enemy to collapse. That is the centerpiece of the future campaign.

To prosecute the future campaign, the Objective Force requires a physical and mental agility, which supports the complexity and time-compressed nature of future warfare, and versatility in force design, which supports adapting to different and changing situations. It also requires increased lethality founded in fires, effects, maneuver, protection and leadership, which enables every combat element to generate combat power and contribute decisively to the fight.

Decisive operations are enabled by a more lethal, versatile, and agile force. This force will combine the synergistic effects of precision fires, information operations, and maneuver. To achieve decisive results, commanders will be required to synchronize the maneuver of widely dispersed forces with the fires of many disparate air, land, and sea warfighting systems.

Full spectrum dominance is enabled by capabilities such as battle command on the move, information dominance, lethality at extended ranges, and precision systems and munitions. Each of these capabilities is enhanced by space-based systems. For example, battle command on the move will be accomplished in part by the use of secure tactical cellular phones linked to communications satellites in low Earth orbit. Information dominance will be enhanced by the use of a shared commercial-civil-national security space-based communications infrastructure, which will provide worldwide, redundant, reliable, and secure communications throughout all phases of an operation. At the same time, critical space components of threat Command, Control, Communications, Computers and Intelligence (C4I) systems and infrastructures will be negated by the application of deception, disruption, degradation, denial, and destruction.

Army weapons linked to real time space sensors and precision navigation systems will provide the ground commander the ability to strike targets in every medium, worldwide, day or night. In some cases, the existence of space-based fire support may allow ground force commanders to deploy without organic fire support assets, shortening the deployment cycle and increasing the speed of operations. Long-range fire support systems will have munitions that receive targeting information in flight. This capability will shorten sensor-to-shooter-to-target timetables, which will speed up the pace of operations, shrink the logistics (ammunition) footprint, and reduce the quantity of strategic lift sorties.

Responsive

Before and throughout a campaign, commanders focus on shaping the battlespace. This activity focuses on seizing and exploiting strategic, operational, and tactical initiatives by positioning and posturing forces for subsequent decisive operation. Activity will include a broad range of actions: to develop a complete understanding of the battlespace; to dominate the air, land, sea, and space spectrums; to deny the enemy freedom of action; and, where possible, to attack his centers of gravity with precision weapons.

Space assets, to include direct downlink and uplink from Army commanders, will not only provide the information to conduct IPB, but be critical to execution of campaigns, battles and engagements. Space assets will be incorporated into the commander's intent and concept to deceive the enemy, assist in the control of space and conduct force application.

Survivable

Given the extreme lethality and accuracy of projected weapon systems, commanders will stress the protection of units and equipment—before, during, and after deployment. The goal will be to develop a fully integrated protective zone around organizations and equipment that will act as a shield against enemy air, land, and sea attack. Inherent in the Army's transformation strategy is reduction of the logistics footprint and the associated reduction of combat support and combat service support personnel and operations within the joint operational arena. This reduced footprint will facilitate force protection, but the requirement remains.

To make the force survivable, the Army must control the battlespace to ensure that its forces maintain freedom of action during deployment, maneuver, and engagement while providing multi-layered defenses for our forces and facilities at all levels. A key enabler of force protection, multi-dimensional joint air defense will be provided by space systems. Space sensors, communications systems, and weapons will form an integral part of theater and national missile defense systems. Warning of ballistic and cruise missile launches will come primarily from space sensors, which will link to ground stations both in CONUS and in theater. Transmissions of warning messages to forces in danger will be accomplished in many instances using communications satellites. Space-based weapons may be used to intercept ballistic missiles in the boost (ascending) phase of flight. Space-based weapons may potentially be used to protect satellites and constellations. Requirements for anti-satellite (ASAT) capabilities must be addressed in the future.

Another fundamental of the new Army construct is reliance upon reach back capabilities to the maximum extent practicable. The extensive use of reach back facilitates force protection. Dispersed operations are supported by space capabilities. Wideband, secure communications passing through space gateways will enable an unprecedented degree of coordination and planning among geographically-dispersed units. Mission rehearsals will be conducted in a virtual environment using information technologies and communications that will in some cases pass through space.

Sustainable

Consistent with the fundamental goals of reducing the logistics footprint and relying upon reach back systems, sustainment in future operations will be centered on a distribution based logistics system (DBLS) where supplies move through a highly visible pipeline, under positive control, from the source to the destination, bypassing routine warehouse and storage functions. DBLS will optimize supply, maintenance, transportation, and distribution. The critical components of distribution are visibility, capacity, and control.

Visibility is the most essential component of a DBLS, where the pipeline is the warehouse. It is, in a sense, inventory in motion. This includes not only visibility of the materiel, but of the entire distribution network. Logisticians require timely and accurate visibility information to distribute assets on time, at the right location, and to the right person; thus maintaining high customer confidence levels and eliminating redundant ordering and excess. A critical DBLS enabler is a space-based global communications system.

Information Dominance

Success on future battlefields will depend on the ability of US forces to establish and maintain information dominance—the condition whereby friendly command, control, communications, and intelligence activities are able to operate unhindered and the enemy's ability to conduct similar activities is severely degraded.

Information dominance is the glue that binds operations together. To gain information dominance, the Army will need to implement seamless, secure, dynamic communications; continuous real time IPB; disrupt enemy information operations; and protect and conceal friendly information operations. Once again, the implementation of these concepts will often take place in or through space. For example, national level sensors based in space will be linked via multidimensional paths to ground commanders, providing them real time intelligence information in sanctuary or on the move. Such architectures will enable split-based operations, making it difficult for adversaries to find and disrupt single points of failure.

Linkage to USCINCSPACE Vision 2020

As the Army proceeds to achieve its space goals within the framework of JV 2010 and the Army Vision, all space assets and capabilities must be congruent and interwoven with USCINCSPACE Vision 2020.

Space operations must be fully integrated with land, sea, and air operations. United States Space Command (USSPACECOM) will assume a dynamic role in planning and executing joint military space operations. Included in that planning should be the prospects for space defense and even space warfare.

The two principal themes of the USSPACECOM Vision are **dominating the space medium** and **integrating space power** throughout military operations. Today, the United States is the preeminent military space power. USCINCSPACE's vision is one of maintaining that preeminence—providing a solid foundation for national security.

The USSPACECOM Long Range Plan (LRP) implements USCINCSPACE Vision 2020. To attain the vision, USSPACECOM has created four operational concepts. These operational concepts provide the conceptual framework to transform the vision into capabilities.

Control of Space is the ability to ensure uninterrupted access to space for US forces and our allies, freedom of operations within the space medium and the ability to deny others the use of space, if required. The ability to gain and maintain space superiority will become critical to the joint campaign plan. As the US military relies more on space, its vulnerability also increases; we must protect our space assets and be able to prevent other nations from gaining an advantage through their space systems.

Global Engagement is the application of precision force from, to, and through space. It is the combination of global surveillance of the Earth (see anything, anytime), worldwide missile defense, and the potential ability to apply force from space. Global Engagement addresses increasing ballistic and cruise missile threats, the need for force application, and the need for effective forward presence with reduced forward basing. At present, the notion of weapons in space is not consistent with US national policy. Planning for the possibility is a purpose of this plan should the civilian leadership decide that the application of force from space is in the national interest.

Full Force Integration seamlessly joins space-derived information and space forces with information and forces from the land, sea, and air. Space power will be instrumental in getting the right military capability to the right forces, at the right time. Space forces must integrate with all our fighting forces—from the Joint Task Force headquarters to warfighters in the land, sea and air components. Innovative organizations and operational concepts, tailored flows of information, and trained, dedicated professionals are all keys to Full Force Integration.

Global Partnerships augment military space capabilities through the leveraging of civil, commercial, and international space systems. This operational concept results from the explosive growth of commercial and international space capabilities. The United States can use these systems to bolster—and decrease the cost of—military capabilities; they will also increase battlespace awareness and information connectivity. Global partnerships can improve stability, offer mutual advantages to all partners and increase flexibility for the United States. Partnerships make possible shared costs, shared risks, and increased opportunities. As we move into the 21st Century, space forces will continue to provide support from space, but will also begin to conduct space operations.

United States Army Space Command (USARSPACE), Army Space and Missile Defense Command (SMDC), and the operational Army must be an integral part of the USSPACECOM Space Planning and Requirements System (SPRS), and the execution of the LRP. USARSPACE supports USCINCSPACE as his Army space component. USARSPACE leverages its operational elements, including: the Army Space Support Cell (ASSC) and the Army Space Support Teams (ARSSTs), which will continue to train, exercise and operate in the role as OPCON to Land Component Commanders (LCC) and Forces Command (FORSCOM) units; JTAGS which provides in theater direct downlink missile warning to theater forces; and DSCSOCs which provide SHF satellite communications, to include GMF, network and payload control.

The main effort for this linkage to the USCINCSPACE Vision lies with the Army, under the direction of Commanding General (CG), USARSPACE and the auspices of CG, Training and Doctrine Command (TRADOC). Concurrent with

USARSPACE efforts, the total Army will engage in a web of activities leading the Army toward true joint linkage at the operational and tactical levels.

As the Army evolves to special staff sections led by FA 40 officers, liaison and connectivity between joint commanders and Army institutions will strengthen relationships and uncover better ways to apply space capabilities.

Through the "service mix" in schools, centers and colleges, the depth and breadth of the space medium will continue to be understood and innovative, progressive applications of space will be derived.

As models and simulations that accurately replicate space are introduced and exposed to leaders during Army and Joint wargames and exercises, appreciation for, and renewed thinking about, space implications will be achieved. The result of emphasizing linkage with USSPACECOM efforts is true operationalization and thereby, normalization of space for the Army.

Methodology - ASMP Azimuth

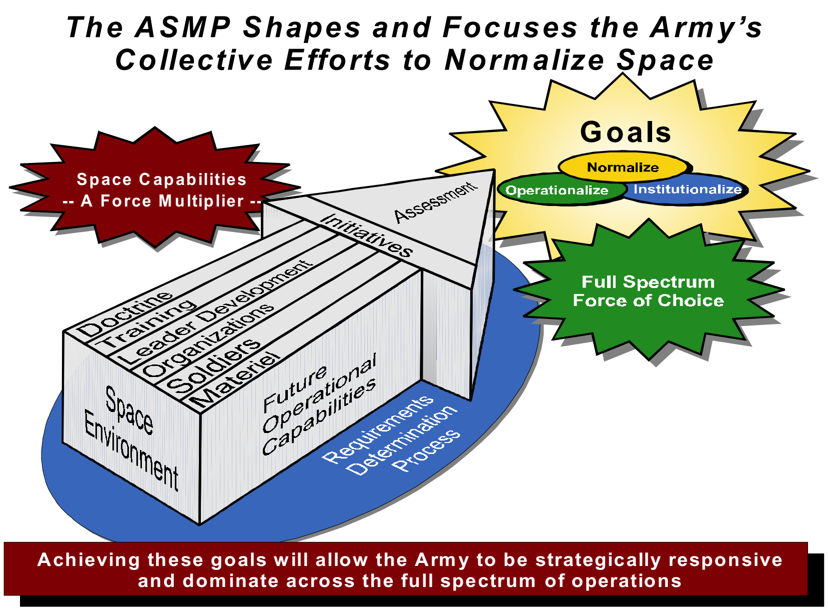


Figure 1-3: ASMP Azimuth

The methodology established in the ASMP begins with the visions of the CJCS, CSA and USCINCSPACE, and related documents (Chapter 1). The figure above depicts this methodology which is carried throughout the ASMP. The Space Environment (Chapter 2) and Army Requirements Determination Process (Chapter 3) are explained prior to entering the TRADOC process, resulting in a focus on Future Operational Capabilities (FOCs) which is analyzed, reviewed, then dissected into three areas: Non-Materiel Activities (Chapter 4), Current Systems and Modernization Strategy (Chapter 5), and Army Space Initiatives (Chapter 6). Space FOCs are then analyzed and assessed in Chapter 7. The ASMP concludes in Chapter 8 with conclusions and challenges for the future.

The ASMP provides a status and an operational analysis of Army space initiatives and programs and serves as a plan to achieve the three Army space goals and achieve the end state of strategic responsiveness and dominance across the full spectrum of operations. It establishes priorities and sets objectives that will lead the Army into the next century.

This plan focuses on future capabilities; it is not a result of a planning, programming and budgeting process that prioritizes space requirements and funding. It reflects the space capabilities the Army will have available through the year 2010 and beyond. In the future, the plan should have a Planning, Programming, and Budgeting System (PPBS) section that addresses separate "space investment" budget lines. Where space related systems are being funded, the ASMP should become a tool of the HQDA for prioritizing the funds available.

Chapter Summaries

Space Environment - Now and Future - (Chapter 2)

This chapter defines the space environment. The environment is not the space medium; rather, it is the body of policies, plans, organizations, agencies, and global threats that influence, enhance and enable the space missions, warfighting concepts, programs, initiatives, and experiments described in later chapters. This chapter begins with a review of three documents that chart the azimuth for future space activities and programs, the *National Space Policy*, the *National Security Space Master Plan*, and the *United States Space Command Long Range Plan*. This is followed by a section that reviews the expanding space community and includes a discussion of the evolving trends in the national security, civil and commercial space sectors. The final section provides a dual-perspective review of the space threat, first from the viewpoint of man-made threats to space systems, and then from the perspective of threats posed by space systems to ground forces. Included in the threat discussion is a review of the global threat environment in which Army space initiatives, concepts, and programs will operate.

Army Space Requirements Determination Process - (Chapter 3)

Chapter 3 describes how space requirements are determined, documented, and processed. It addresses the Space Requirements Determination Process managed by the SMDC in coordination with designated TRADOC branch proponents. The chapter specifically addresses:

- The space requirements coordination and integration procedures detailed in the TRADOC and SMDC Memorandum of Agreement signed in February 1997.
- The Army's role in joint requirements determination.

- National and Joint policy documents that impact on space requirements determination.
- The Army Space Requirements Determination Process detailed in SMDC's Draft Handbook for Requirements Determination.
- The status of the document and activities that currently affect the generation of space requirements with emphasis on the space warfighting concept and the FOCs derived from that concept.

Non-Materiel Activities - (Chapter 4)

The Army will make a quantum leap in the operationalization, institutionalization, and normalization of space in the near term through the synchronization and emphasis on the non-materiel means to improve readiness. Three pillars form the foundation to institutionalize a space mindset in the immediate future: 1) leader development, training and education, 2) embedding a special staff section at corps level, and investigating the need at division-level and below, and 3) documented space integration across the spectrum of cornerstone documents and publications. This must be achieved by the focused integration of space throughout the Army's colleges, schools and centers, as well as organizational (unit) training.

Current Systems and Modernization Strategy - (Chapter 5)

This chapter presents an overview of the space systems and their related ground segments of most interest to the Army out to the year 2005, with extrapolation out to the year 2020. The modernization strategy reflected is driven by improving on past capabilities while preparing for the digital age to be ushered in with the first digital division in 2000 and the first digital corps in 2004. With sufficient capacity in space and on the ground, space capabilities and products will allow Army commanders and units to gain and maintain information superiority and full spectrum dominance.

The Army's requirements for space capabilities are expected to significantly increase during the next two decades. The promise of continued digitization and information superiority is highly dependent on assured access to adequate space and related ground assets and seamless integration with complementary capabilities. The strategies for modernizing individual systems presented in Chapter 5 represent a bridge to realizing the Army Vision.

Army Space Initiatives - (Chapter 6)

The objective of this chapter is to define space initiatives (technology developments, experiments and demonstrations) that are designed to satisfy the Army's space FOCs as contained in TRADOC Pamphlet 525-66 (FY98 Draft). These initiatives also support the Army's concept of operations as articulated in TRADOC Pamphlet 525-5 and TRADOC Pamphlet 525-60.

Capabilities Assessment - (Chapter 7)

The assessments grade the projected Army space capability to meet the FOC challenges for the near-term

(FY00-04), the mid-term (FY05-10) and for the far-term (FY11-25). Capabilities are rated against the operational requirements for each time period. From the force enhancement perspective, the FOC process is on-track and attacking the capability combat multipliers. However, in those capability areas traditionally supported by other Services, Army space initiatives are lacking. Offensive space control is a prime example.

Conclusions and Challenges - (Chapter 8)

This chapter draws conclusions from the previous chapters, and completes the ASMP methodology. It connects the goals and analyses, and charts the course for the Army in the near-, mid- and far-terms.

Summary

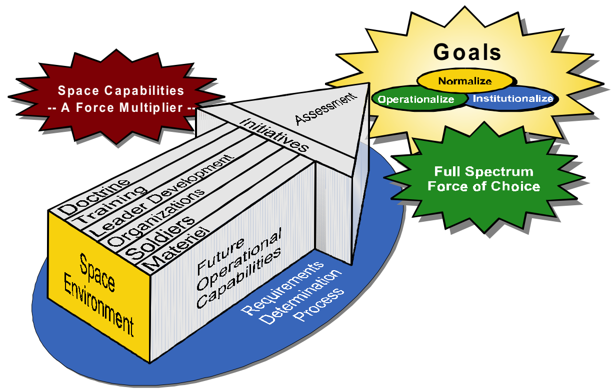
The Army has sharpened its focus on achieving the benefits and advantages to be derived from space capabilities, and as the Army transforms, opportunities to integrate space capabilities increase. The challenge will be to effectively pursue Doctrine, Training, Leader Development, Organizations, Materiel, and Soldiers (DTLOMS) solutions to the space FOCs for the 2010 and beyond time frame. Achieving these goals will require unprecedented cooperation with the Army's Joint and Service space partners and the commercial space community. No "good idea" should be discounted and all lessons learned must be shared. The price for space superiority may be high but the advantages will be extraordinary!

The ASMP is the first step towards attaining the operationalization, institutionalization, and normalization of space for the warfighter and implementing a coherent Army space strategy. It is a serious and necessary attempt by the Army to integrate and synchronize Army space support for the land warrior. The next Army Space Master Plan will expand upon this plan, to include specific strategies and timelines to address operational concepts and the space mission areas. The establishment of a TRADOC Tier-1 Space Integrated Concept Team (ICT) will be an integral part in developing the actual content of the next ASMP. The long term intent is to shape and influence the Department of Defense (DoD) PPBS; the Joint Space Requirements Generation Process; DoD, Services, Non-DoD Agencies, industry, and academia science and technology development; and to ultimately develop an interoperable set of space and terrestrial architectures to achieve full spectrum dominance.

Space is the high ground today, tomorrow, and in the future. It is the fourth dimension—a joint environment providing a broader vertical perspective of the battlespace. Space is also a complex environment with a multitude of nations, corporations, and international consortia conducting a wide range of space operations for economic and military benefits and vying for dominance. If the Army is to maintain overmatch capabilities, space systems must be shaped and influenced to provide the information and support our forces require to conduct decisive operations across the full spectrum of conflict. This Army Space Master Plan provides the overall direction and guidance necessary to implement the Army space policy.

Chapter 2: Space Environment - Now and Future

Leaders must understand policy requirements and implications, as well as threats to Space.



Introduction

This chapter defines the space environment not in terms of the physical medium of space, but rather in terms of the policies, plans, organizations, agencies, and global threats that influence, enhance, and enable the space missions, warfighting concepts, programs, initiatives, and experiments described in later chapters. This chapter begins with a review of policy, long range planning, and visionary documents that chart the azimuth for future space activities and programs. The next section reviews the expanding space community and includes a discussion of the evolving trends in the national security, civil, and commercial space sectors. The final section provides a dual-perspective review of the space threat, first from the viewpoint of man-made threats to space systems, and then from the perspective of threats posed by space systems to ground forces. Included in the threat discussion is a review of the global threat environment in which Army space concepts and programs will operate.

Space Policy, Long Range Planning, and the Revolution in Military Affairs

A number of National and Department of Defense (DoD) policies, strategies and vision documents provide the foundation for the overall space environment. Four documents are of significant importance to Army planners due to their current and future applicability to Army space programs and activities. These four documents are the *National Space Policy* (1996), the *National Security Space Master Plan* (1996), the *Army Space Policy* (1994), and the United States Space Command *Long Range Plan* (1998).

National Space Policy

The *National Space Policy* (NSP), signed in September 1996 by President Clinton, was the first space policy update in the post Cold-War era. The policy reaffirms many of the basic principles of previous policies while directing considerable attention to the civil and commercial space sectors. The goals of the US space program, as outlined in the NSP, are to:

- Strengthen and maintain the national security of the United States;
- Enhance knowledge of the Earth, the solar system and the universe through human and robotic exploration;
- Enhance the economic competitiveness, and scientific and technical capabilities of the United States;
- Encourage state, local and private sector investment in, and use of, space technologies; and
- Promote international cooperation to further US domestic, national security, and foreign policies.[1]

The NSP states that the Secretary of Defense (SECDEF) and Director of Central Intelligence (DCI) oversee national security space activities. The NSP also establishes that national security space activities contribute to our national security by:

- Providing support for the US inherent right of self-defense and for our defense commitments to allies and friends;
- Deterring, warning, and, if necessary, defending against enemy attack;
- Assuring that hostile forces cannot prevent our own use of space;
- Countering, if necessary, space systems and services used for hostile purposes;
- Enhancing operations of US and allied forces;
- Ensuring our ability to conduct military and intelligence space-related activities;
- Satisfying military and intelligence requirements during peace and crisis as well as through all levels of conflict; and
- Supporting the activities of the national policy makers, the Intelligence Community (IC), the National Command Authority (NCA), combatant commanders and the military Services, other federal officials, and continuity of government operations.[2]

National Security Space Master Plan

The *National Security Space Master Plan* (NSSMP) is the DoD's "strategic business plan" for space programs. Table 2-1 lists the "Guidestars" of the NSSMP. A Guidestar, when associated with the NSSMP, refers to a long range national security space goal that the DoD and IC should be trying to achieve. The intent of the NSSMP is to provide the DoD and IC with a common vision of the national security space capabilities required in 2020 and provide guidance on how these needs may be satisfied. The NSSMP focuses on policies, capabilities, and practices that should exist beyond the Future Years Defense Program (FYDP).

National Security Space Master Plan Guidestars	
Technology Superiority	Ensure United States dominance in national security space capabilities through revolutionary technological approaches in critical areas
Customer Focus	Develop a responsive, customer-focused national security space and ground architecture that simplifies operations and use
Cooperation	Ensure civil and commercial capabilities are used to the maximum extent feasible for national security space activities. Consider the use of international capabilities where appropriate
Access	Provide assured, cost-effective, responsive access to space
Information Collection	Provide comprehensive and timely intelligence, surveillance, and reconnaissance of Earth and space through integrated use of space, airborne, land, and sea assets
Information Handling	Ensure space systems are seamlessly integrated within a globally accessible information infrastructure
Sharing	Provide appropriate national security space services and information to the civil, commercial, scientific, and international communities
Protection	Protect national security space systems to ensure mission execution
Space Control	Provide space control capability consistent with Presidential policy, US and International Law
Force Application	Explore concepts, doctrine, and technologies consistent with Presidential policy, US and International Law
World-class Workforce	Promote a trained, space-literate national security workforce able to fully utilize space capabilities for the full spectrum of national security operations

Table 2-1: National Security Space Master Plan (NSSMP) Guidestars

The NSSMP provides senior leadership with the long-range guidelines necessary to make the transition from the FYDP to the future (2020) in a conscious, deliberate, and well thought out manner. Further, the plan shows how national security space systems support the *National Security Strategy* (NSS) and the *National Military Strategy* (NMS). The scope of the NSSMP includes all DoD and IC national security space activities.[3]

Army Space Policy

"The Army's future is inextricably tied to space."

Army Space Policy
July 1994

The *Army Space Policy* (ASP), approved by the Secretary of the Army (SecArmy) and CSA in July 1994, recognizes that the Army is dependent on space systems, capabilities and products. The ASP states that the Army "will conduct space and space-related activities that enhance operational support to warfighters and contribute to successful execution of Army missions." Related to its Title 10 responsibilities, the ASP states that "beyond affecting future space systems design and developmental initiatives, the Army, in joint and combined operations, will organize and train Army forces using space capabilities and projects to make them more responsive, flexible, interoperable, survivable, and sustainable." The ASP also acknowledges that space must be embedded in Army doctrine, training scenarios, war games, exercises, and plans. Finally, the 1994 ASP establishes the concept of "***normalizing space***" in the preparation for and conduct of assigned missions. The 1994 ASP is a succinct statement of the Army's overarching position on space. It is as relevant today as it was when it was developed. The text of the ASP is included on the inside cover of this document.

United States Space Command Long Range Plan

The *Long Range Plan* (LRP) implements the USSPACECOM Vision for 2020. The plan provides a vector for the evolution of military space capabilities that will enable the operational concepts outlined in *JV 2010*. The USSPACECOM Vision for 2020 identifies four operational concepts that were derived from the Unified Command Plan (UCP), the anticipated strategic environment and *JV 2010*. These operational concepts are described in Chapter 1.

Revolution in Military Affairs

> ***"Victory smiles upon those who anticipate the changes in the character of war, not upon those who wait to adapt themselves after the changes occur."***
>
> **Guilio Douhet**

Each of the four documents described above (NSP, NSSMP, ASP, and LRP) has a future focus. These documents, along with the NSS, NMS, intelligence estimates and The Army Plan provide Army planners with an azimuth to frame the future environment in which the Army will be called upon to operate. The challenge for these planners is to define the future environment and introduce change at the right time. "Adapting to change is difficult for an army. At best, changing a military organization too quickly may result in acquisition of immature or inappropriate capabilities. At worst, it can threaten the doctrinal and organizational cohesion on which any fighting force depends. But as armies throughout history have learned to their dismay, failure to adapt is equally deadly."[4]

The Army After Next (AAN) initiative was charged to assist in the development of a vision of future Army requirements (focus 30 years into the future). The AAN initiative was the Army's method of investigating future warfare to foster innovative thinking and chart a potential course of change, a strategy, to achieve what many are calling a "Revolution in Military Affairs (RMA)." The Office of the Secretary of Defense (OSD) defines an RMA as "a major change in the nature of warfare brought about by the innovative application of new technologies which, combined with dramatic changes in military doctrine and operational and organizational concepts, fundamentally alters the character and conduct of military operations."[5]

The Joint Staff's *Concept for Future Joint Operations (CFJO)* acknowledges the emergence of three major RMA ideas. The first involves operations and tactics and is described as "long-range precision weapons, with unprecedented worldwide mobility, coupled with effective sensors, C2 systems, and precise intelligence."[6] The second is the emergence of information operations. "Information is critical to every aspect of military operations. Information technologies have dramatically improved our ability to gather, process, store, and disseminate information in near real-time. Protecting the effective operation of one's own information systems and exploiting, degrading, destroying, or disrupting the opponent's will become a major operational focus."[7] The third idea involves the increased use and application of space systems. "This [space] exploitation will impact all aspects of military operations, enhancing information systems and relevant information capabilities, dominant battlespace awareness, and C2 capabilities. The potential emergence of space as a warfare theater will alter its military importance. The ability to locate and destroy, with a high degree of confidence, high-value fixed and mobile targets on earth and in space may fundamentally change how we think about and conduct war. These same capabilities could also impact other present-day military tasks such as peacekeeping and humanitarian assistance missions."[8]

While space systems are obviously involved in the third emerging RMA idea postulated by the Joint Staff, they also enhance or enable each of the other two ideas as well. Many Army initiatives, along with efforts conducted by OSD and the other Services, are developing insights that provide Army space planners with knowledge and insight into the nature of future warfare. This knowledge, when combined with the azimuth charted by the NSP, NSSMP, ASP and LRP, significantly reduces the risks associated with the challenges confronting these planners as they attempt to define the future environment and introduce change within the Army.

The National Security, Civil, and Commercial Space Sectors

United States space activities are conducted by three separate and distinct sectors: two strongly interacting governmental sectors (Civil and National Security) and a separate, non-governmental Commercial Sector. Close coordination, cooperation, and technology and information exchange will be maintained between the Civil and National Security sectors to avoid unnecessary duplication and promote attainment of United States space goals.

National Space Policy
September 1996

This section provides a foundation for the follow-on chapters of this ASMP. While not intended to be an exhaustive compilation, it provides data and information on organizations, agencies, departments and industry markets interacting in the space community. Included is a discussion of the evolving trend of convergence of the three space sectors (national security, civil, and commercial) into a more closely integrated and interdependent future environment.

National Security Space Sector

The National Security Space Sector includes both the DoD and the IC. Within this sector, the United States spends about $7 billion each year executing its defense space program.[9] This huge investment in space was the focus of considerable congressional attention throughout the 1980's and into the 90's. Congressional concerns centered on expenditures, but also included policy, requirements, acquisition, operations, training, and support to the warfighter.[10]

From 1994-1995, the DoD conducted a review of the organization and management of national security space activities to address the concerns expressed by Congress. The review focused on improving the integration and coordination of all DoD space activities as well as improving the integration and coordination of defense and intelligence space activities. As a result of this review, the Office of the Deputy Under Secretary of Defense for Space [DUSD(Space)], the DoD Office of the Space Architect (DoDOSA) and the Joint Space Management Board (JSMB) were formed.

The United States recently completed yet another transition with respect to the organization of national security space functions. In late 1997, the SECDEF directed a major reorganization within the OSD. The specifics of the reorganization were outlined in the Secretary's Defense Reform Initiative (DRI) Report (November 1997). Based on the Secretary's guidance in the DRI Report, several studies were initiated. One of these studies, or initiatives, is significant regarding space. It is entitled the "Reorganization of DoD Space Management Responsibilities." Under this initiative, USCINCSPACE and the Director of the National Reconnaissance Office (DNRO) were tasked to realign the non-policy responsibilities of DUSD(Space), better integrate the functions of the DoDOSA with the National Reconnaissance Office (NRO) Space Architect, and make recommendations for a new streamlined approach to the management and oversight of defense and intelligence space activities. The study resulted in the establishment of a National Security Space Architect (NSSA) office that will develop and integrate DoD and intelligence space systems architectures. The NSSA combines the DoD and NRO Space Architects into a single office. The NSSA reports to the Assistant Secretary of Defense for Command, Control, Communications and Intelligence (ASD/C3I) for matters within the cognizance of the SECDEF and to the DCI for matters within the cognizance of the DCI. In addition, the study resulted in the disestablishment of the JSMB and the establishment of a Senior Steering Group (SSG) that will vet stakeholder equities and ensure compliance with policy and guidance. The Defense Resource Board (DRB)/Extended DRB (EDRB) was identified as the senior decision-making authority for all national security space architectures. Finally, the ASD/C3I assumed all of the functions previously performed by DUSD(Space).

The National Security Space Sector includes both the IC and the DoD space organizations. The next section provides information and descriptions of elements within the IC and DoD that have significant space research, development, acquisition and operational impact on the current and future Army.

Intelligence Community Segment of the National Security Space Sector

The IC consists of 13 government agencies and organizations, headed by the DCI, that carry out the intelligence activities of the US government (Figure 2-1). Each of these 13 agencies and organizations plays a role in the space environment. The IC designs, builds, and operates space systems and processes and exploits and disseminates space products. While each of the members plays a role in the national security space environment, four are addressed (Army Intelligence, the

National Security Agency, the National Imagery and Mapping Agency and the National Reconnaissance Office) in this section due to their significant role in current and future Army operations.

Army Intelligence

As with other Services, Army Intelligence is a member of the IC. Army Intelligence is designed to provide timely, relevant, accurate and synchronized intelligence and electronic warfare support to tactical, operational and strategic level commanders across the full range of Joint military operations. This support comes from a wide range of organizations and units that are fully integrated into the national security space infrastructure. These organizations include Military Intelligence (MI) units organic to Corps and lower echelons, and MI units from the Army Intelligence and Security Command (INSCOM) which provide support to Echelons Above Corps (EAC) and various strategic intelligence activities. This structure provides tactically tailorable deployment packages in support of warfighters and supports a broad range of operational planning and force development activities.

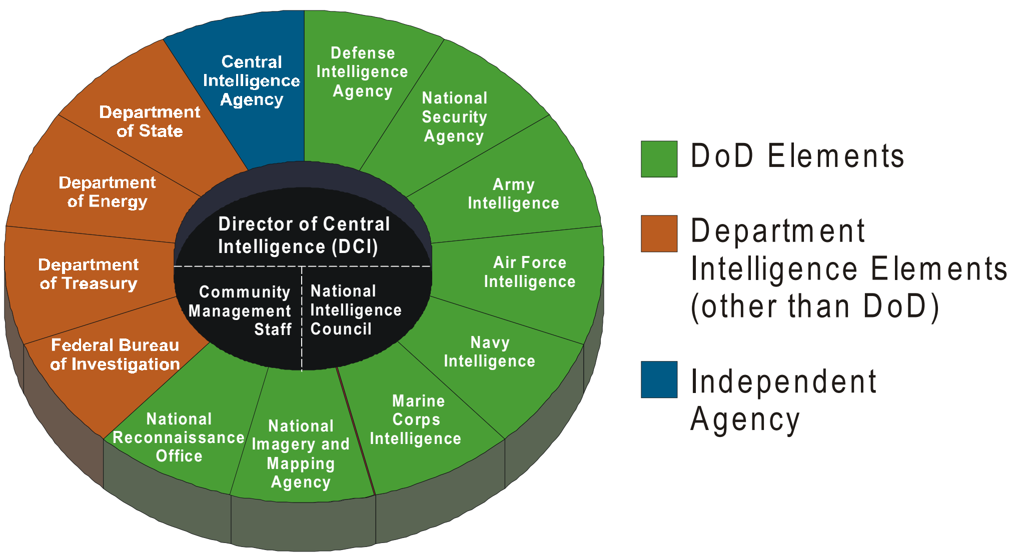


Figure 2-1: The Intelligence Community

National Security Agency

The National Security Agency (NSA) was founded in 1952. The fundamental mission and core competency of NSA is cryptology, a skill that provides the US with an ability to understand secret foreign communications while protecting our own. In addition, NSA plans, coordinates, directs and performs SIGINT and information security functions in support of both Defense and non-Defense related activities. While the 1996 *National Space Policy* declassified the fact that the US conducts overhead SIGINT collection and it is generally acknowledged that many of NSA's missions are based in the space environment, the details and methods of the agency remain classified and are therefore not covered in this document.

National Imagery and Mapping Agency

The National Imagery and Mapping Agency (NIMA) was established

October 1, 1996 by the National Imagery and Mapping Act of 1996. NIMA's creation centralized responsibility for imagery and mapping in a single agency. This single agency focus provides streamlined procedures for customer access to imagery and mapping products while exploiting the potential of collection systems, digital signal processing technologies and the expansion in availability of commercial imagery. NIMA's mission is to provide timely, relevant and accurate imagery intelligence and geospatial information in support of national security objectives. NIMA is the agency responsible for processing and disseminating satellite-based photo-reconnaissance products.

National Reconnaissance Office

The NRO designs, builds, and operates the nation's reconnaissance satellites. A DoD agency, the NRO is staffed by DoD and Central Intelligence Agency (CIA) personnel. The Director of the NRO is also dual-hatted as the Assistance Secretary of the Air Force for Space. The mission of the NRO is to enable US global information superiority during peace and war. The NRO is responsible for unique and innovative technology, large-scale systems engineering, development and acquisition, and operation of space reconnaissance systems and related intelligence activities needed to support global information superiority.

DoD Segment of the National Security Space Sector

Deputy Assistant Secretary of Defense for C3ISR and Space Systems

The organizational changes resulting from the SECDEF's Defense Reform Initiative are significant with respect to space. The ASD/C3I has authority over a broad range of military activities to include space, airborne reconnaissance and electronic warfare (EW). Four Deputy Assistant Secretaries of Defense (DASD) will report to the ASD/C3I. These four DASD's are: Intelligence; Security and Information Operations; Chief Information Officer Policy and Implementation; and Command, Control, Computers, Intelligence, Surveillance, Reconnaissance and Space Systems (DASD C3ISR & Space Systems). The DASD (C3ISR & Space Systems) includes four directorates, a space policy office and a spectrum management office. The four directorates are: 1) Directorate of Communications and Command and Control Battle Management (oversight of satellite and other communications systems issues); 2) Directorate for ISR Systems (surveillance systems to include the Space-Based Infrared System (SBIRS) missile warning and tracking programs); 3) Directorate of Program Analysis and Integration (military space acquisition management); and, 4) the Directorate of Space (space launch, space control, satellite control, inter-agency matters, and all navigation and environmental space systems).

Joint Staff

The Joint Requirements Oversight Council (JROC) reviews and validates all space requirements, to include military intelligence requirements. In addition, various Joint Staff directorates perform functions directly related to space operations (J3 for space operations and planning, J5 for space policy, and J6 for communications services). Of particular note are two Joint Staff, J3 entities with specific space mission responsibilities. The NRO's Deputy Director for Military Support has J35 responsibilities (as does the Deputy Director for National Support Systems). The Deputy Director for Current Readiness and Capabilities (J38) has a Defense and Space Operations Division which is responsible for all matters pertaining to space operations, which includes: space launch; satellite system status; Integrated Tactical Warning and Assessment; JCS liaison to USCINCSPACE, the NRO, and NORAD; Joint Missile and Air Defense; and the integration of space issues and subjects into the Joint Warfighting Capabilities Assessment process. Additionally, the J38 is the JCS TENCAP office, and is responsible for the coordination, development, staffing, and publication of the DoD TENCAP Annual Report, and the execution of JCS Special Projects. The J38 also acts in the capacity of the J35's staff on all JCS space issues and actions.

Defense Information Systems Agency (DISA)

The mission of this DoD organization is to plan, engineer, develop, test, manage, acquire, implement, operate, and maintain information systems for Command, Control, Communications, Computers and Intelligence (C4I) and mission support under all conditions of peace and war. DISA identifies six core mission areas: 1) Global Command and Control Systems (GCCS); 2) Defense Information System Network (DISN); 3) Defense Message System (DMS); 4) Global Combat Support System (GCSS); 5) Defense Information Infrastructure Common Operating Environment (DII COE); and, 6) Information Security (INFOSEC). DISA established a Commercial Satellite Communications Initiative (CSCI) and an office to manage the process, the CSCI Management Office (CMO).

The CMO is a centralized facility established to support all warfighter commercial satellite communications requirements. The CMO addresses requirements for communications in the C and Ku bands. The CSCI is a Congressionally mandated DoD program that uses leased transponders, network management, and earth terminals to satisfy non-warfighting, mission essential satellite communications at cost savings. The CSCI is designed to accomplish two primary objectives. First, reduce the long-term cost of providing commercial satellite communications (SATCOM) support to all DoD customers while providing pre-positioned surge capability to support the joint task force (JTF) and related missions. Second, introduce new information transfer services to the joint warfighter and mission support elements of the Defense Information Infrastructure (DII). The CMO also provides a Bandwidth Management Center (BMC) to monitor and control resources and to coordinate with DoD Global and Regional Control Centers.

US Army

There are many offices and organizations within the Army that play a role in the planning and execution of space support services. The Army's specified proponent for space is the US Army Space and Missile Defense Command (USASMDC). In its role as the Army space proponent, USASMDC is the focal point for space requirements integration and solutions, space science and technology development, and space technology integration. Annex F contains a comprehensive diagram of the agencies, organizations, and commands within the Army space community that execute space responsibilities.

The Army established a working group to bring together the Army's internal space community, called the Army Space Executive Working Group (ASEWG). The ASEWG is a formal, Headquarters, Department of the Army-sponsored group comprised of Colonel (O-6) representatives with space or space-related functional interests. The ASEWG formulates, debates and coordinates official Army positions on DoD space issues, facilitating the participation of the Army leadership and all organizations affected by space issues. The ASEWG also identifies, formulates, and recommends issues for the Army Space General Officer Steering Committee's (GOSC) consideration. The ASEWG serves to reinforce the Army's intent to speak as "one voice" on space-related issues and efforts. Membership on the ASEWG includes: the Director, SMDC Force Development and Integration Center (Chairman); Director, Space and Advanced Concepts (SALT); Chief, Battle Space Surveillance and Operations Division (DAMI-POB); Deputy Chief of Staff for Operations and Plans, Space and Special Weapons Division; Director, Space and Information Operations Directorate (TRADOC SIOD); Director, Remote Sensing Laboratory, Topographical Engineer Center; U.S. Army Material Command; Director of Information Systems for Command, Control, Communications and Computers; Deputy Chief of Staff for Personnel; Deputy Chief of Staff for Logistics; United States Army Space Command (Forward); and other participants as invited by charter members.

US Navy

The Navy headquarters agency responsible for space matters is the Director of Space, Information Warfare, Command and Control (N6) on the Chief of Naval Operations (CNO) staff. This office exercises direct control over Naval Space Command (NAVSPACECOM). N6 responsibilities include centralized control over space policy and planning. Additionally, N6 is responsible for the integration of requirements for space, space exploitation (except for requirements under the aegis of the CIA) and space defense matters. N6 is also responsible for reconnaissance and ocean surveillance and combat identification.

US Air Force

The Air Force includes air and space superiority as one of its six core competencies. The Air Force Long Range Plan includes a goal to fully integrate space and air into all operations as they transition from an air force into an air and space force on an evolutionary path to a space and air force.[11] The Air Force has a large number of organizations and offices dedicated to the space effort on both the Secretariat staff and the Air Staff. These offices execute responsibilities ranging from launch to spacecraft design, development and on-orbit operation.

United States Space Command

USSPACECOM is the combatant command that employs military space forces and provides operational space support to other combatant commands and the NCA. It conducts all integrated tactical warning and attack assessment and space operations, including control of space, direction of space support activities, and use of space assets to enhance the effectiveness of other operational forces. USSPACECOM is headquartered at Peterson AFB in Colorado Springs, Colorado and operates the Space Control Center (SCC), Missile Warning Center (MWC), and NORAD/USSPACECOM

Combined Intelligence Center (CIC). It also directs space support operations for assigned spacecraft systems, including the Defense Support Program (DSP), the Defense Satellite Communications System (DSCS), the Global Positioning Systems (GPS), Air Force Satellite Communications System (AFSATCOM) payloads, Fleet Satellite Communications (FLTSATCOM), and the Defense Meteorological Satellite Program (DMSP).[12]

US Army Space Command

USARSPACE is the Army Component Command to USSPACECOM and the single operational space element for the Army. As such, USARSPACE plans and executes space operations to include space control, space support, force enhancement, and force application. USARSPACE accomplishes these missions through the command and control of the 1st Satellite Control Battalion, the Joint Tactical Ground Stations (JTAGS), Regional SATCOM Support Centers (RSSC), and Defense Satellite Communications Systems (DSCS) Operations Centers (DSCSOC). USARSPACE provides Army Space Support Cells (ASSC) and Army Space Support Teams (ARSST) in support of land component commanders and manages Army astronauts. USARSPACE also assists in developing Army space concepts and doctrine when directed by SMDC.

Naval Space Command

The Naval component of USSPACECOM is NAVSPACECOM, located in Dahlgren, Virginia. NAVSPACECOM operates assigned space systems to provide surveillance and warning, as well as spacecraft telemetry and on-orbit engineering support. The Alternate Space Control Center (ASCC) is located at NAVSPACECOM. The Navy operates a system of radar transmitters and receivers across the lower portion of the United States in a “fence like” array that detects all objects that penetrate its radar beam. NAVSPACECOM oversees two other operational Navy activities: the Naval Satellite Operations Center and the Fleet Surveillance Support Command.

Air Force Space Command

The Air Force was the first service to establish a major command dedicated to the space mission. Air Force Space Command (AFSPC), activated in 1982 at Peterson Air Force Base (AFB), Colorado, organizes, trains, equips, funds and advocates for future space forces and resources. AFSPC has two numbered air forces assigned—the 14th and 20th.

The Fourteenth Air Force, headquartered at Vandenberg AFB, California, manages the generation and employment of space forces to support USSPACECOM and North American Aerospace Defense Command (NORAD) operational plans and mission. As the Air Force’s component to USSPACECOM, 14th Air Force prepares forces, assesses their readiness, and exercises operational control of 28 space systems at 44 worldwide locations. The 14th AF commands and controls launch units operating out of two launch ranges located on the east (Cape Canaveral Air Station) and west (Vandenberg AFB) coasts of the United States. The 14th AF’s mission also includes tracking all satellites and other orbiting objects through its worldwide Space Surveillance Network (SSN), controlling most military satellites through its worldwide Air Force Satellite Control Network (AFSCN), and the operations of ground- and space-based missile warning systems. The 14th Air Force is a Major

Subordinate Command of AFSPC. The headquarters of 14th AF is located at Vandenberg AFB in California.

Twentieth Air Force, located at F.E. Warren AFB, Wyoming, operates and maintains AFSPC's Intercontinental Ballistic Missile (ICBM) weapon system in support of US Strategic Command war plans. Another subordinate unit, the Space Warfare Center (SWC), integrates space systems into the operational Air Force and explores and tests new ways to use space systems to support warfighters.

Civil Space Sector

National Aeronautics and Space Administration

The National Aeronautics and Space Act, effective 1 October 1958, created the National Aeronautics and Space Administration (NASA) and gave it a broad charter for civilian aeronautical and space research. Today, NASA is organized in four *Enterprise* areas: Aeronautics, Human Exploration and Development of Space, Earth Sciences, and Space Sciences.

The mission of NASA is to: 1) explore, use, and enable the development of space for human enterprise; 2) use the environment of space for research and advance scientific knowledge of the Earth, the solar system, and the universe; and 3) research, develop, verify, and transfer advanced aeronautics, space, and related technologies. NASA's goals are to be at the forefront of exploration and science, to develop and transfer cutting-edge technologies in aeronautics and space, and to establish a permanent human presence in space.

Department of Transportation

The Commercial Space Launch Act of 1984 authorizes the Department of Transportation (DoT) to regulate US commercial space launch activities. The Office of Commercial Space Transportation (OCST) within the Federal Aviation Administration carries out the Department's responsibilities. OCST is responsible for encouraging, facilitating, and promoting commercial space launches by the private sector and for recommending changes in Federal statutes, treaties, regulations, policies, plans, and procedures to execute this responsibility.

DoT also plays a major role in the Global Positioning System (GPS) arena. On March 29, 1996, Vice President Gore announced a new US GPS policy. The policy's primary goal is to support and enhance economic competitiveness and productivity while protecting US national security and foreign policy interests. The policy established a permanent Interagency GPS Executive Board (IGEB) to manage GPS. The IGEB consults with US Government agencies, US industries, and foreign governments involved in navigation and positioning system research, development, operation, and use. Membership on the IGEB includes representatives from the Departments of Defense (OSD) and Transportation (co-chairs), the Joint Staff, and the Departments of Commerce, Interior, and Agriculture.

Department of Commerce

Five offices within the Department of Commerce (DoC) are key players in the space environment: the National Oceanic and Atmospheric Administration (NOAA), the Office of Aerospace within the International Trade Administration, the Office of Air and Space

Commercialization (OASC) within the Technology Administration, the Bureau of Export Administration, and the National Telecommunications and Information Administration (NTIA).

NOAA is a functional environmental scientific agency composed of the National Ocean Service, National Weather Service, National Marine Fisheries Service, National Environmental Satellite Data and Information Service, and Office of Oceanic and Atmospheric Research. The creation of NOAA on October 3, 1970 was the result of a series of decisions that recognized the importance of the oceans and atmosphere to the nation's welfare and economy.

Within NOAA, the National Environmental, Satellite, Data, and Information Service (NESDIS) is charged with the management and operation of the nation's weather satellite programs, to include system development and data processing and distribution. The history of NESDIS can be traced back to the Coast & Geodetic Survey magnetic investigations in the 19th century and to Weather Bureau scientists' efforts in the early 1950's to press for the development of satellites for weather studies. The launch of TIROS-1 in April 1960 by NASA initiated the use of space to monitor the earth's environment (payload control and ground processing for TIROS-1 was accomplished at Fort Monmouth, NJ). Under the authority of the 1992 Land Remote Sensing Policy Act and subsequent administration policies such as the U.S. Policy on Foreign Access to Remote Sensing Capabilities, NOAA/NESDIS is also responsible for licensing the operations of commercial remote sensing (imagery) satellites.

The primary mission of the Office of Aerospace within the International Trade Administration is to promote American commercial and economic interests related to international trade and investment in aerospace products. The office is responsible for advocacy, trade promotion and development of international trade policies related to space in order to promote the competitiveness of U.S. industry, and it has supported the U.S. Trade Representative in negotiations and consultations of the commercial space launch agreements with Russia, China and Ukraine.

OASC is charged with identifying, developing, and advocating space technologies and national policies that build America's economic strength. The office publishes an annual document that identifies industry trends in the commercial space arena.

The Bureau of Export Administration is responsible for licensing the export of communications satellites and certain export licenses on space-qualified components.

The National Telecommunications and Information Administration (NTIA) was established in 1978 by Executive Order 12046. NTIA is the Executive branch telecommunications policy advisor to the President and the manager of Federal Government uses of the spectrum.

Federal Communications Commission (FCC)

The FCC is responsible for managing use of the frequency spectrum by the public (including state and local governments). The FCC is an independent regulatory agency that reports to the Congress of the United States. The mission of the FCC is to encourage competition in all communications markets and to protect the public interest. In response to direction from Congress, the FCC develops and implements policy concerning interstate and international communications by radio, television, wire, satellite, and cable. The FCC regulates the private sector's use of the spectrum, largely by developing and enforcing rules mandated by legislation and licensing private companies' use of the radio spectrum. Regulations are on a case-by-case basis, in response to industry and private needs and according to the votes of the FCC's five commissioners. The FCC works closely with the NTIA, which manages the Federal government's use of the spectrum. The FCC, along with NTIA and the Department of State (State leads the US delegation), represent the United States at the biennial World Radiocommunications Conference (WRC). The WRC, under the auspices of the United Nations, decides issues that affect the development of telecommunications provided through use of the radio spectrum. In preparation for the next conference in 2000, the FCC established several working groups to review issues, provide advice and technical support and recommend proposals for WRC-2000. The working groups are currently developing positions on a number of WRC-2000 issues to include GPS, mobile satellite communications, and fixed satellite services.

Commercial Space Sector

Commercial investment in space technology is quickly outpacing that of the government. Global 1996 space industry revenues exceeded $76 billion and by the year 2000, commercial space industry revenues are expected to exceed $100 billion.[13] Of note, 1996 marked the first year on record that commercial investments surpassed government expenditures.

The global space industry is a significant international economic sector that generates high-growth investment opportunities. Today, thousands of companies ranging from huge multinational firms to small entrepreneurial start-ups are aggressively applying space-related products and services to the needs of a wide range of emerging markets.

While several areas of commercial interest and endeavor will affect the Army, three in particular have important significance to current and future Army operations. These are commercial launch, telecommunications and remote sensing services.

Commercial Launch Services

The commercial space transportation industry has existed since 1989. The first commercial launch featured a sub-orbital Starfire booster from White Sands, New Mexico. Later that same year, a Delta I successfully placed a British Satellite Broadcasting communications satellite in orbit. Since those first two launches in 1989, there have been more than 100 worldwide commercial launches using Delta, Titan, Atlas, Athena, Pegasus, Ariane, Long March (China), Proton (Russia), and START-1 (Russia) boosters. On September 19, 1996 the first Commercial Launch Site Operator’s License was issued to Spaceport Systems International for operation of the California Spaceport at Vandenberg AFB. Other licenses have since been issued to Spaceport Florida

Authority for operations at Cape Canaveral and to the Virginia Commercial Space Flight Authority for operations at NASA's Wallops Flight Facility. On May 19th, 1999 Spaceport Systems International (SSI) announced the operating capability of its Spaceport Launch Facility at Vandenberg Air Force Base, California.

The market for commercial launch services is expanding rapidly. Various predictions identify requirements for between 250 and 365 satellite launches to geosynchronous Earth orbit (GEO) over the next 10 years. Low Earth orbit (LEO) and medium Earth orbit (MEO) satellite communications requirements may exceed 1,000 spacecraft over the same timeframe. These requirements as well as potential and emerging markets in remote sensing, space manufacturing, hazardous waste disposal, tourism, power generation and ultra high speed civil transport are driving the expansion of this market.

Commercial ventures are underway in both the expendable and reusable launch vehicle categories. These programs, coupled with the Air Force's Evolved Expendable Launch Vehicle (EELV), will introduce competition, thus driving launch costs down. Therefore, the Army will find it easier and cheaper to get capabilities to orbit. New and expanded commercial services will be available for use by military forces. In addition, significant decreases in the developmental time to get a capability on orbit could potentially alter the acquisition equation. New commercial space systems focused on the tactical user could become a reality. A responsive launch capability (Launch on Demand) could produce a means for rapid constellation reconstitution. Each of these possibilities could have a dramatic impact on space support to warfighting operations.

Telecommunications

Defined as fixed and mobile satellite services and direct-to-home television, this sector generated almost $9 billion in direct revenues in 1996 and is expected to directly produce $29 billion by 2000. Indirect revenues from long-distance and international telephony and satellite-based cable distribution services were approximately $13 billion in 1996 and are forecast to reach almost $17 billion in 2000.[14] Telecommunications services have historically been the primary source of industry revenue in the space environment, operating in several commercial markets since the 1960s. Most of these systems operate from GEO but the current trend is toward LEO and MEO systems that capitalize on emerging Global Mobile Personal Communications by Satellite (GMPCS) markets. These markets consist of three broad categories of service providers (Table 2-2):

- Big LEO: These systems are designed to provide real time voice services such as global cellular communications, paging, and data through hand-held mobile terminals. "*Big*" refers to a category of non-geostationary satellite systems that provide global voice, paging, and data services.

- Little LEO: These are data-oriented systems designed to provide messaging services, tracking and positioning. "*Little*" is used to describe non-voice, non-geostationary mobile satellite service systems. These services provide radio location and two-way data messaging services.

- Broadband LEO/MEO: Data-oriented systems designed to provide a wide range of customer services to include internet, voice telephony, video, and videoconferencing services.

While the current trend in telecommunications is towards the lower orbit regimes, the traditional GEO satellite services are also expanding. Trends noted in the GEO satellite industry include:[15]

- Demand - Average demand for launch of commercial GEO payloads will be approximately 33 per year in the period 1997-2010.

- Growth - A period of significant growth is projected for 1998-1999 followed by a decline, the second, but less aggressive, cycle of growth beginning in the 2003-2004 timeframe.

- Payloads - The mass distribution of commercial payloads reflects a trend towards heavier satellites. Factors influencing the demand for heavier commercial satellites include the availability of several new heavy-lift launch vehicles, the increased cost effectiveness of larger spacecraft (on a dollars per transponder basis), increasing spacecraft power requirements, larger antennae and increased orbital congestion.

LEO and MEO Personal Communication Systems[16]

Type System	Name	Operator	# Satellites Planned	Freq
Big LEO	Ecco	Constellation	46	L
	Ellipso	Ellipsat (MCHI)	17	L
	Globalstar	Globalstar LP	48	L/S
	ICO	ICO Global Comm	10	S
	Signal	KOSS	48	L
	Iridium	Iridium LLC	66	L/S
Broadband LEO and MEO	West	Matra Marconi Space	9	Ka
	Teledesic	Teledesic	288	Ka
	Sky Bridge	Sky Bridge	80	Ku
Little LEO	Gonets D	Smolsat	36	UHF
	LEO One	LEO One USA	48	VHF
	Orbcomm	Orbcomm	48	U/VHF
	SAFIR	OHB Teledata	6	UHF
	Courier	Elas Courier Complex	8	UHF
	E-Sat	E-Sat (Echostar)	6	VHF
	Vitasat	VITA	2	U/VHF
	Temisat	Telespazio	7	UHF
	FAIsat	FACS	26	U/VHF
	Iris (LLMS)	SAIT Systems	2	UHF
	Gonets R	Smolsat	45	S/L
Total Number of Spacecraft (planned)			**846**	

Big LEO:	Voice oriented systems, telephony
Broadband LEO and MEO:	Data oriented systems, video
Little LEO:	Data oriented systems, messaging

Table 2-2: LEO and MEO Personal Communication Systems

Commercial communications systems offer tremendous potential for the Army. Commercially provided data messaging (battlefield paging), secure cellular voice transmission without line-of-sight restrictions, internet access, videoconferencing, and a wide range of other services could satisfy many Army requirements. In an era of reduced budgets, personnel downsizing, and a tendency toward “outsourcing,” the Army must be prepared to utilize commercially available systems to meet operational warfighting requirements. In FY99 the Army’s Signal Architecture Master Plan will address capacity requirements to exploit commercial capabilities.

Remote Sensing (Imagery)

The Land Remote Sensing Policy Act of 1992 established responsibility for the development of geographic remote sensing satellites (Landsats) with the Department of Commerce. The Act also required private sector marketing of Landsat data and authorized Commerce to license the operation of private remote sensing systems. Since 1992, 11 licenses have been granted.

Remote sensing is the process of imaging the Earth’s surface. Of significant importance in remote sensing technology is the concept of image resolution, or the closest distance that two objects can be together and still be reliably distinguished. High resolution systems provide a capability to distinguish relatively small objects, or those that are closely spaced. Imagery taken at 3-meter resolution allows analysts to distinguish tactical vehicles (HMMWVs and civilian cars) from combat vehicles (tanks and larger trucks). Imagery taken at 10-meter resolution does not allow a distinction between cars and trucks.

Another key concept for imaging systems is the spectral regime in which the system operates. While a small number of commercial systems plan to operate synthetic aperture radar (SAR) systems (active emitters of radar energy), most commercial systems will be passive collectors of reflected light. These systems collect light of various frequencies on a focal plane and process it into digital images, operating in panchromatic and/or multi-spectral modes. Panchromatic (or visible light grayscale) images are suitable for detecting the shapes of objects by their boundaries and shadows. These images are commonly used in mapping. Multi-spectral imaging uses color (visible and infrared light) to determine types of objects, such as vegetation, soil, water, or clouds. There are many possible spectral bands that can be used by a remote sensing system. Some are ideal for one set of applications, while others are ideal for a different set. Since the technology for providing a large number of different bands is currently in the research and development phase, remote sensing system builders must make compromises between many potential users in order to determine the set of bands that will satisfy the most users.[17]

A third concept that is necessary for complete understanding of remote sensing systems is the concept of turnaround time. Turnaround time is the elapsed time from user request to image delivery. While many factors contribute to turnaround time, two are dominant:

- The time it takes for an image to be taken by a satellite and delivered to the ground (determined by the system architecture, including satellite design, choice of orbit, and the number and location of ground stations).

- The time it takes to process an image on the ground once it has been received from the satellite system and deliver it to the user (determined by the degree of automation in ground processing and the choice of data delivery mechanism).[18]

Timeliness is also affected by how frequently a remote sensing system repeats its ground track. Systems that repeat their ground track in short time intervals are potentially applicable for use in conducting battle damage assessments (BDA). Table 2-3 lists remote sensing systems currently on orbit or planned for launch through 2002.

Commercial Remote Sensing Systems[19]						
Name	Data Provider	Launch Date	Resolution (m)			Revisit Time (Days)
			Panchromatic	Multi-Spectral	Radar	
Operational Systems						
Landsat-5	Space Imaging	Mar 1994		30 to 80		16
Landsat-7	USGS	April 1999	15	30 to 60		16
Spot 2	Spot Image	Jan 1990	10	20		1-4
Spot-4	Spot Image	Mar 1998	10	20		1-4
ERS-1	Eurimage	July 1991			26	168
ERS-2	Eurimage	Apr 1995			26	3-35
IRS-1B	Space Imaging	Aug 1991		36.25 to 72.5		22
IRS-P2	Space Imaging	Oct 1994		36.25		22
IRS-1C/1D	Space Imaging	1995/1997	5.8	23.5 to 70.5		24
SPIN-2	Aerial Images	Feb 1998	2-10			16-17
Radarsat-1	Radarsat International	Nov 1995			7.6 to 100	3-35
CBERS-1	China/Brazil	Oct1999	20	20 to 160		26
Ikonos-2	Space Imaging	Sept 1999	.8	3.2		3-5
Planned Systems						
CBERS-2	China/Brazil	2001	3			
IRS-P5 (CartoSat)	Space Imaging	2000	2.5	10		26
Quickbird-1	Earthwatch, Inc.	2000	.8	3.3		1-4
Orbview-3	Orbimage	2000	1 to 2	4	8	3
EROS A 1,2	West Indian Space	2000	1.8			2-4
EROS B 1-6	West Indian Space	2001+	.82			2-4
IRS-P6 (ResourceSat)	Space Imaging	2000	10	23		22
ENVISAT-1	Europe	May 2000		30		35
GDE	GDE	2000	1			16
NEMO	NRL/STDC	2000	5	30 to 60		3
Orbview-4	Orbimage	2000	1	4 to 8		3
Resource 21	Resource 21	2000		10 to 20		7
Quickbird-2	Earthwatch	2000	.8	3.3		1
SkyMed	ASI	2001	1 to 2.5	5	3	5
Radarsat-2	Radarsat International	2001			3 to 100	24
Radar 1	RDL Space	2001			1	TBD
Spot-5	Spot Image	2002	2.5-5	10		26
Aries	Aries Consortium	2002	10	30		7

Table 2-3: Commercial Remote Sensing Systems

Remote imaging systems are of tremendous potential value to the Army. Use of these systems across the spectrum of military operations will increase as the resolution capabilities of these systems approach those needed for targeting and battle damage assessment functions. Commercial systems add robustness to the national imagery architectures available today and could potentially influence the design of future national imagery systems. The Army is investigating the role that commercial remote sensing systems will have on the not-to-distant future battlefield in demonstrations such as Eagle Vision II (see Chapter 5).

Convergence of the Three Space Sectors

In 1996, for the first time in our short history of space activities, commercial launches exceeded military launches in the United States. This transition in the space launch arena portends a much larger transition that encompasses a convergence, across all functions and operations, of the three space sectors. The potential impacts of this convergence on current and future warfighting are just now being analyzed. The next two sections identify trends and provide insights into this convergence phenomenon, first from a military perspective and then from the viewpoint of commercial industry.

National Security Perspective

One means the Army is using to analyze the trend toward convergence is the AAN Initiative. AAN, which is developing insights and impressions on warfare in the 2020-2025 timeframe, includes the emergence of commercial space services as a major area of study. Wargames conducted to date have surfaced several impressions and insights on commercial space services. These insights will be analyzed in depth in an effort to develop operational concepts and technologies that may enhance the land component commander's ability to achieve full spectrum dominance over a future military adversary.

From a more near-term military perspective, the impacts of national security, civil, and commercial space are primary elements of the *NSSMP* (see Table 2-1) and the United States Space Command *LRP*. The *LRP* provides an initial analysis of how the national security space sector may develop partnerships with the civil and commercial space sectors. This analysis provides Army planners with a glimpse of potential warfighter requirements that will require DTLOMS solutions.

One area of analysis is the distinction between core and non-core military space activities. This effort identifies those space missions deemed as core competencies and those that are acceptable for partnering. If a capability is deemed a core military capability, it will not likely be a candidate for significant partnering outside of the national security and (potentially the civil) space sectors. Non-core military competencies comprise the population of capabilities with high probabilities for partnering, outsourcing and privatization. The characteristics of core USSPACECOM functions include those involving the operation of military space systems. Non-core functions are characterized by the ability to share current systems, data and capabilities or to use commercial-off-the-shelf products. Some of the non-core functions can include sharing missile warning data with allies, employing common command and control and force integration systems, obtaining weather data from NOAA, contracting for satellite communications, imaging data, or launch services.[20]

A second area of analysis involves a conceptual integrated systems approach for all current and future military space capabilities. This concept has the potential to pay huge dividends in financial savings and cost avoidance. An integrated systems approach could result in the identification of common requirements or opportunities for efficiencies across service and civil programs, auxiliary payloads integrated at low cost, and multiplication of effects of efficiencies through common designs and interfaces.

Civil and Commercial Perspective

Analysis of the convergence trend from the civil and commercial perspectives identifies characteristics similar to those of the national security sector. The Department of Commerce's Office of Air and Space Commercialization has identified six trends that are defining the future global space industry. The following descriptions of these trends are extracted from their report, *Trends in Commercial Space-1996*.[21]

Globalization

The space industry is inherently global. More than 20 countries have active national programs related to the development of space infrastructure, with the United States, Europe, Russia, China and Japan leading the way. In addition, many developing nations purchase space-related products and services such as satellite-based telecommunications systems and remote sensing data. Emerging markets in Eastern Europe, the former Soviet republics, Africa, South America, and the Pacific Rim represent significant opportunities for the space industry. These opportunities have led to an international expansion through mergers, acquisitions, and strategic partner arrangements.

Deregulation and Privatization

The global trend toward deregulation of telecommunications has given rise to a multitude of new competitors, services, and markets serviceable by the space industry. Additional space-related commercial opportunities are being created by the privatization of many traditional government space activities. In the US, government-owned national launch ranges are now licensed to private concerns, and many suppliers of defense-related space infrastructure who formerly sold exclusively to the government are now permitted to compete commercially.

Capital Market Acceptance

The financial community is increasingly recognizing the emergence of the space industry as a mainstream industrial activity with powerful growth characteristics. Successful financial performance should continue to attract capital to the industry, thereby institutionalizing the space industry in the capital markets. While capital market acceptance is still not as widespread as for information technology ventures, the financial community has begun to recognize that many ventures with a space component are not as risky as previously thought. Satellite telecommunications projects still remain the preferred space industry investment.

Technology Convergence

The convergence of telecommunications and information technologies will continue to fuel commercial growth for advanced information products and services for a global mobile community. The inherent "look-down" advantages of space-based capabilities will continue to provide an effective means for delivering services and gathering information on a regional or global basis.

Government Funding

Space-based capabilities have become integral to the defense community. R&D expenditures are expected to be stable for both civil and defense initiatives. Government expenditures related to deploying space infrastructures are expected to continue, with a higher utilization of commercially developed capabilities. This increasing reliance on space assets for defense operations will provide a revenue base for continued space technology development in the commercial sector.

Emergence of New Industry Leaders

The small to medium size firms in the space industry generally have been on the forefront of commercial innovation. They often possess the low-cost infrastructure and commercially-oriented market behavior necessary to capitalize quickly on market opportunities and to compete effectively. Given the substantial size of the worldwide space industry and the emergence of numerous commercially viable niches, many of these companies can experience ample growth without inviting significant competitive response.

Space Threat

> ***In 2020, prior to hostilities or during peace operations, an adversary will have sophisticated regional situational awareness. Enemies may very well know, in near real time, the disposition of all forces. They will command and control their forces with real-time access to precise navigation (position and timing), submeter imagery, highly accurate weather data, timely missile warning, and robust communications.***
>
> **United States Space Command**
> **Long Range Plan**
> **April 1998**

The *National Military Strategy* identifies several global threats in today's complex strategic environment and the potentially dangerous future environment that we now envision. Today, Cold War era adversaries cooperate with us across a broad range of security issues including space. Russia is a partner in the International Space Station (ISS). Future US launch vehicles (both military and commercial) will employ rocket motors designed and fabricated in Russia. Many commercial satellites are launched on Russian and Chinese launch systems (for example, Iridium) and military payloads may one day be launched from foreign soil on foreign boosters.

Space, just like all sectors of the national security environment, is successfully adapting military alliances to new realities and building relationships with old and new partners, both nation state and commercial enterprises. However, regional dangers persist, and the potential for conflict among states and groups of states remains the primary security concern of the United States.[23] Some of these state and non-state actors in the strategic security environment may resort to asymmetric means to counter the dominance of US military forces. In the area of space operations this is a critical concern. The use of asymmetric methods and technologies against US military forces includes at least two dimensions when viewed from the space operations perspective. First, space may play a role in deterring, detecting, combating or monitoring asymmetric means such as terrorism, weapons of mass destruction (WMD) and information warfare. Second, space systems are high value targets for these types of asymmetric means.

The security environment is further complicated by challenges that transcend national borders and threaten our national interests. Ethnic disputes, extremism and religious rivalries, international crime, illegal trade of weapons, WMD materials, illegal drugs, refugee flows, and environmental hazards are significant threats to our national interests. Space systems may play significant roles in countering these transnational dangers because they transcend national boundaries and geographic borders.

In 1998, the National Air Intelligence Center (NAIC) recently released a report entitled *Threats to US Military Access to Space*.[24] This report includes three key judgments related to the threat to space systems and the threats an adversary could pose to the US military if they have access to commercially-available space services:

- The US military depends on national and commercial space systems of both domestic and foreign (or international consortia) origin. Several forms of offensive operations could affect these systems. Offensive threats including deception, disruption, denial, degradation, or destruction could seriously affect US warfighting capabilities.

- Space systems are potentially susceptible to offensive counterspace operations. First, several countries routinely conduct denial and deception operations that affect US reconnaissance satellites. Almost all countries could implement some degree of denial and deception operations. Second, most potential adversaries could attack the ground facilities associated with US space systems. Third, many potential adversaries have the means to disrupt or deny satellite communications, data and command links. Finally, commercial satellite communications are at particular risk. US military satellite communications could also be disrupted or denied by a determined adversary. Fourth, although historically only the former Soviet Union possessed the means to directly attack satellites on orbit (a capability that has probably been preserved by Russia), global technology leveling is leading to the proliferation of anti-satellite (ASAT) threats. Several countries have the technology and infrastructure to directly threaten US satellites in a limited fashion, and more will have this ability in the future.

- Potential adversaries could challenge US access to space by taking advantage of a range of offensive counterspace capabilities within their technological means. Larger potential adversaries could develop capabilities that would provide them a robust, highly flexible capability to influence the space environment. Smaller adversaries could implement relatively inexpensive capabilities that would affect the US military's ability to fully leverage space capabilities in a regional confrontation.

Threats to Space Systems

The next section details the threats to space systems. Joint Pub 1-02, DoD Dictionary of Military and Associated Terms, defines a space system as *all of the devices and organizations forming the space network. The network includes spacecraft satellite, (ground) control stations, and associated terminals/ receivers* (Figure 2-2).

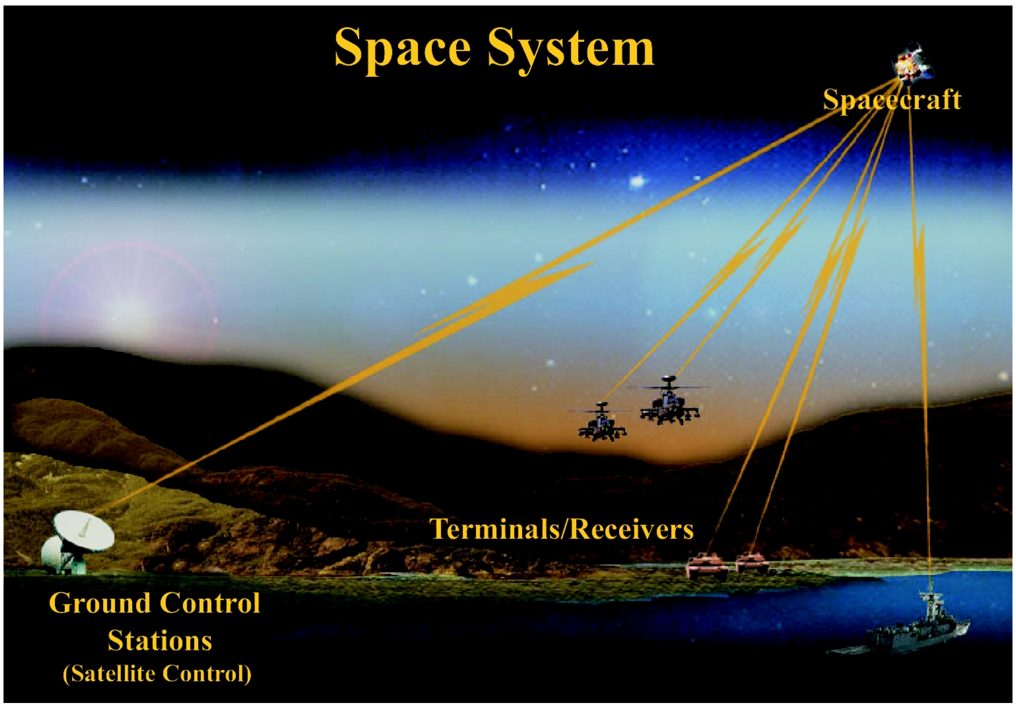


Figure 2-2: Space System Definition Pictorial

These threats comprise the methods available to conduct negation operations, one of four sub-missions in the space control mission area. The other sub-missions are protection of space systems, prevention of adversary use of US and allied space systems and surveillance of space. From the Army's perspective, protection of space systems is the highest priority within the space control mission area due to our forces' increasing dependence upon space capabilities. If an adversary is able to conduct offensive counterspace operations against US, allied or commercial space systems, the force enhancement qualities they possess are negated with potentially devastating impact on the force. Therefore, it is important for Army planners to understand the threat to space systems so they can identify requirements for space system protection. Today, there are only minimal protection methods employed on US space systems. Critical military satellites such as early warning (missile attack) and strategic communications assets include some form of enhanced protection (anti-jam, nuclear hardening). However, most US military space systems and virtually all commercial space systems are vulnerable to attack. Given the threat outlined in the next section, Army planners must develop positions for the level of protection required on each space system utilized by Army forces in the execution of assigned missions.

Threats to a space system can take many shapes and forms and may be directed at any of the network segments. Threats to space systems involve the use of lethal or nonlethal means to accomplish deception, disruption, denial, degradation and destruction objectives. To accomplish these objectives, four categories of offensive counterspace operations could be conducted. These four categories include denial and deception (D&D), ground segment attack and sabotage, electronic attack and space segment attack using ASAT systems. The operations conducted within these offensive counterspace categories vary significantly in terms of their utility, difficulty, cost, and effectiveness (Table 2-4).

Offensive Threats to Space Systems[25]				
Method	**Potential Targets**	**Relative Difficulty to Implement**	**Pros**	**Cons**
Denial and Deception	Reconnaissance Systems	Low	• Can be conducted in peacetime	• Effective only if all participants strictly adhere to program • Limited target set
Ground Station Attack and Sabotage	All Systems	Low	• Highly effective when there are a few ground facilities associated with a system or service. • Effects are essentially permanent • Sabotage could be conducted in peacetime	• Physical attack of facilities inside the US may have negative repercussions
Electronic Attack	Communications, Navigation and Data Links	Moderate	• Low cost; possible to affect multiple receivers	• High Signature - can be targeted • Only effective while electronic attack system is operating
ASA	All Satellites	High	• Effective when the ratio of ASATs to target set is low • Effects are essentially permanent	• High cost • Used only in wartime or just prior to war

Table 2-4: Offensive Threats to Space Systems

Denial and Deception

D&D operations are the most common form of counterspace operations used today. Counterspace D&D operations can be categorized in two types: directed and nondirected. Both types employ camouflage, concealment and deception (CC&D) techniques to deny or corrupt intelligence collection by satellites. Nondirected D&D activities are conducted routinely and may or may not be a direct response to US reconnaissance efforts.[26] This form of offensive counterspace operation has no physical impact on the space system and therefore generates no concern for Army planners with respect to space system protection. Directed D&D operations are undertaken during spacecraft overflight. Given the ability to predict when spacecraft will be overhead, D&D methods are used to limit or corrupt the data obtained from reconnaissance satellites. These methods are easy to implement and are therefore an attractive and asymmetric means to diminish information superiority.

Many methods are available to potential adversaries to determine and predict spacecraft orbits. Orbital information on US satellites is collected by amateur astronomers and posted on the internet. These observers have a worldwide network and have been known to produce highly accurate orbit predictions on satellites alleged by the astronomers to be US intelligence collection spacecraft. Some countries have deployed a network of space surveillance radars and/or optical sensors to track satellites of concern. Optical instruments (telescopes) to accurately track satellites are relatively inexpensive and commercially available worldwide.

Ground Segment Attack and Sabotage

This is the offensive counterspace method best understood by Army planners and the one against which Army forces may be required to defend. Physical attack of ground facilities could be accomplished through various means to include conventional attack (direct and indirect fires), special operations forces attack, air and sea delivered munitions, cruise and ballistic missiles, information operations, terrorist attacks, and hacker intrusions. As described in Table 2-4, this offensive counterspace method targets all space systems and is relatively easy to implement using existing military forces. Targets include all elements of the ground segment of a space system. These elements include launch facilities, data reception, processing, exploitation and dissemination nodes, command and control facilities, spacecraft and booster assembly locations and supporting infrastructure.

Electronic Attack - Space Link Segment Attack

Many potential weapons in this category exist. Threats can be either terrestrial-based (e.g., ground or airborne jammers) or space-based. These include jamming and spoofing. Jammers emit noise-like signals in an effort to mask or prevent the reception of desired signals. Spoofers emit false, but plausible, signals for deception purposes. All military and commercial satellite communications systems are susceptible to uplink and downlink jamming and spoofing. Jammers can attack space system uplinks or downlinks. In general, uplink jammers must be roughly as powerful as the emitter associated with the link being jammed. Since downlink jammers have a range advantage over the space-based emitters, they can often be much less powerful and still be effective. The targets of downlink jammers are ground-based satellite data receivers, ranging from large fixed ground sites to handheld GPS user terminals. Downlink jamming is generally easier than uplink jamming since very low power jammers are often suitable, though their effects are local. The targets of uplink jammers are the satellite receivers-including sensors and command receivers. The effects of uplink jamming may be global since the satellite or space system would be impaired for all users. If false commands can be inserted into a satellite's command receiver (spoofing), they could cause the spacecraft to tumble or otherwise destroy itself. Insertion of false information or computer viruses into the terrestrial computer networks associated with a space system, either remotely or through an on-site connection is also highly probable given the level of information warfare capabilities available today. Such an attack could lead to space system degradation or even complete loss of spacecraft utility.[27]

Anti-Satellite - Space Segment Attack

There are a number of natural environmental hazards to spacecraft. The space medium is a dynamic environment consisting of highly charged particles, radiation and innumerable objects varying in size from microscopic to the largest meteoroids and asteroids. Temperatures on the sunlit side of an object can be very high, yet extremely low on the opposite side. Charged particles continually bombard exposed surfaces and magnetic fields that vary in intensity influence spacecraft components on a continual basis. All of these factors influence the design and operation of space systems. Due to these design features, spacecraft have limited inherent protective measures from some forms of ASATs. However, the ASAT threat must still be considered since systems can be developed to exploit a number of spacecraft susceptibilities to disruption, denial, degradation or destruction techniques. In this plan, ASATs are classified into two generic categories: interceptors and directed energy weapons.

Interceptors

Four categories of interceptors can be envisioned. First, low-altitude direct-ascent interceptors launched from a ground, air or sea platform into a suborbital trajectory that is designed to intersect that of a LEO satellite (e.g. SMDC's KE ASAT technology effort). Second, low-altitude co-orbital interceptors launched from ground, air or sea platforms into an orbit from which they maneuver to intercept a LEO satellite. Third, high-altitude, short duration interceptors launched from a space launch vehicle into a temporary parking orbit, from which the interceptor maneuvers to engage a highly elliptical orbit (HEO), MEO, or GEO satellite typically within one to twelve hours. Finally, long-duration interceptors launched into a storage orbit, where they await commands to engage a target satellite—either LEO, HEO, MEO or GEO. Feasible concepts in this category include space mines, orbiting interceptors, space-to-space missiles and space-based weapons.[28]

Directed Energy

Directed energy (DE) weapons may also be divided into several distinct categories. First and most likely is laser energy. Depending on spacecraft design, satellites are vulnerable to component damage from various frequencies of laser energy. If the spacecraft is an imaging satellite, the focal plane could be damaged or destroyed by high-energy radiation. If the laser is of sufficient power and quality, components could be heated, penetrated, or severed from the spacecraft. Feasible threats in this category include ground-based, airborne, and space-based lasers.

A second category includes weapons that utilize High Power Microwaves (HPM) to generate a pulse of energy that damages and destroys spacecraft electronic components.

A third category includes high-altitude nuclear detonation. While such an event would generate electromagnetic interference that would complicate satellite and terrestrial communications, the primary threat posed by a high altitude nuclear burst is the release of high-energy radiation into the space environment. The nuclear burst generates large numbers of prompt X-rays. These X-rays lose energy and dissipate as they travel away from the point of detonation but any spacecraft in the general location (depending on size or yield) of the burst is affected by extremely high energy X-rays that cause catastrophic damage to silicon chips and other electronic components. The second effect of concern is the charging of the Earth's magnetic field resulting in higher radiation levels over time than spacecraft are designed to withstand. The total dose of radiation is multiplied many times resulting in much shorter mission lifetimes than design specifications.

Threats to Terrestrial Forces from Space Systems

From a purely space perspective, reliance/dependence on space-based systems and products will increase both friendly and adversary potential for engagement. The US military's move toward knowledge-based forces and systems demands access to space-based services that will be generated by military, civil, commercial and international space sources. While the trend toward commercial use of space enhances US military forces, the same is true for potential adversaries. Any nation or organization with monetary resources can have access to advanced technology and space-based products and services. This will include submeter (less than 1 meter resolution) imagery products, precise navigation and timing services and prolific communications services that may obviate the need for a nation to incur the expense of developing, launching and operating indigenous communications systems.

Threats from space systems to terrestrial forces may be categorized in the force enhancement functional areas of communications, intelligence, surveillance and reconnaissance (ISR), precise navigation and timing services, and weather terrain and environmental monitoring (WTEM). The next sections identify threats to US military forces from force enhancing space services available to potential adversaries.

Communications

Military commanders must be aware that robust, worldwide communication services will be available to any potential adversary. These services will include all the capabilities discussed in the previous section of this chapter (Table 2-2). Many of these systems are foreign owned or administered by an international consortium of companies. Restricting access or terminating service will be complicated and difficult to accomplish.

Intelligence, Surveillance and Reconnaissance (ISR)

The change in American policy regarding the licensing of commercial imaging satellites was in response to the emergence of commercially viable satellite imaging programs in France, Russia, China, India, Israel and a number of other states. As shown earlier in Table 2-3, a number of commercial efforts to develop imaging systems are claimed to provide militarily significant (targeting quality) data to a worldwide customer base. These systems must be considered by military commanders due to the ease of access by anyone with resources to purchase the imagery. However, at least in the near-term, most commercial systems will not be capable of providing the resolution required by military planners to conduct targeting or battle damage assessment (BDA). Table 2-5 provides data on the resolution requirements for certain militarily significant target sets. When these data are compared to the resolutions included in Table 2-3, it is clear that many of these systems will not provide the resolution required to conduct targeting (precise ID required). These systems are still significant, however, in terms of their ability to provide an adversary with near-real-time imagery—a capability that heretofore with the exception of major military powers (Russia, China, France, Israel) was unavailable.

Ground Resolution (m) Requirements for Militarily Significant Targets[29]

Target	Detection	General ID	Precise ID	Description	Technical Analysis
Vehicles	1.5	0.6	0.3	0.06	0.045
Radio	3	1	0.3	0.15	0.015
Radar	3	1.5	0.3	0.15	0.015
Command and Control HQ	3	1.5	1	0.15	0.09
Missile Sites (SSM/SAM)	3	1.5	0.6	0.3	0.045
Aircraft	4.5	1.5	1	.15	.09
Airfield Facilities	6	4.5	3	0.3	0.15
Bridges	6	4.5	1.5	1	0.3
Troop Units	6	2	1.2	0.3	0.15
Roads	6-9	6	1.8	0.6	0.4
Surface Ships	7.5-1.5	4.5	0.6	0.3	0.045
Coasts, Landing Beaches	15-30	4.5	3	1.5	0.15
Railroad Yards	15-30	15	6	1.5	0.4
Ports, Harbors	30	15	6	3	0.3
Urban Areas	60	30	3	3	0.75
Terrain Features	90+	90	4.5	1.5	0.75

Definitions

Detection	Location of a class of units, objects, or activity of military interest
General ID	Determination of general target type
Precise ID	Discrimination within targets
Description	Size/dimension, configuration/layout, components, equipment count, etc.
Technical Analysis	Detailed analysis of specific equipment

Table 2-5: Ground Resolution Requirements for Militarily Significant Targets

Precise Navigation and Timing

The US military's experiences in Desert Storm have not gone unnoticed to its potential adversaries. The use of the Global Positioning System by US and coalition forces greatly enhanced their ability to navigate in the featureless desert environment. Since the Gulf War, the commercial and civil use of GPS has expanded greatly. GPS receivers are available from an expanding number of worldwide sources. Recent decisions to cease selective availability (the process of degrading the accuracy of GPS signals for civil and commercial users) and the development of a second civil GPS signal will increase accuracy for all users—friendly and potential adversary alike. Many nations are developing GPS jammers that vary from handheld size with a limited, line-of-sight range, to larger, more powerful aircraft mounted versions that are capable of covering a much broader area of the military theater.

Of potentially greater concern to the Army is the current and future use of the GPS timing signal for synchronization of communications systems and networks. The GPS timing signal provides accuracy within billionths of a second. This level of accuracy, available worldwide, allows improved synchronization and timing of both wired and wireless communications systems. This capability results in fewer dropped calls, increased capacity, and improved data transmission (low error rates). Many of the military's communications systems are already dependent on the GPS timing signal for reliable operation. An adversary that has the capability to deny the GPS signal through jamming not only affects the force's ability to navigate but also its ability to communicate. These effects could have devastating impacts on an information dependent force.

Weather, Terrain, and Environmental Monitoring (WTEM)

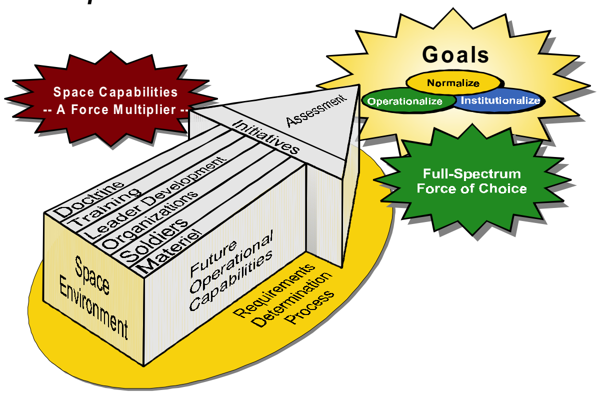
The convergence of US space-based weather monitoring systems into a single, joint civil and DoD agency is another step in the universal availability of militarily significant weather data. In the future, weather data will be available to any user that purchases the terminals and receivers to receive satellite broadcasts. This data will come from a large number of sources to include US, Japanese, European, Russian, and other systems. The remote sensing systems described in the previous section and listed in Table 2-4 provide the majority of worldwide terrain and environmental monitoring services. From a terrain analysis perspective, improvements in these systems to detect greater numbers of frequencies at higher resolutions make these systems militarily significant. These systems will be capable of providing information on soil moisture content, location of restricted terrain, and many other militarily significant categories of information. US military planners must be prepared to face an adversary that has access to commercially available information that tends to level the playing field in the battle to achieve information dominance.

Summary

This chapter provided definition to the space environment; the body of policies, visions, strategies, long range plans and global threats that influence current and future Army space programs and services. That environment is in a state of transition. The emergence of the commercial sector as a source of militarily significant data and information will shape change within the national security space sector. Improving and expanding policies and planning documents will provide a common vision and direction for national security space sector activities. The growth in space support to the warfighter described in this chapter is complementary to the larger Revolution in Military Affairs apparent in today's national security environment. The benefits of this growth will come from a combination of new and visionary technologies with improved organizational and operational methods and concepts. The remaining chapters of this Army Space Master Plan outline the warfighting concepts, programs and initiatives that the Army is pursuing to ensure it takes advantage of the RMA. The next chapter addresses the Army's warfighting concepts and identifies future operational capabilities relating to space that the future force will require.

Chapter 3: Army Space Requirements Determination Process

Future holistics Army Space capabilities are attained by understanding and following the Requirements Determination Process.



Introduction

This chapter focuses on the generation of space requirements. It describes how these requirements are documented and how the Army's space requirements determination process (managed by SMDC in coordination with appropriate branch proponents) will help provide space support to the warfighter in the first decades of the 21st Century. The chapter specifically addresses:

- Selected National, DoD, and Joint policy documents that influence space requirements.
- The space requirements coordination and integration procedures detailed in the TRADOC-SSDC Memorandum of Agreement (MOA) signed in February 1997 which addresses interrelated space and missile defense responsibilities within the two commands.
- SMDC's role in assisting USSPACECOM in the development of joint space requirements.
- The Army Space Requirements Determination Process established in accordance with TRADOC Pam 71-9 (Requirements Determination).
- The status of current Army space requirements documentation and requirements-related activities.
- Space support to future warfighting concepts.

Space Guidance

The Army Space Requirements Determination Process draws its initial direction from key national, DoD, and joint policy documents. These documents impact heavily on the roles and missions of the armed forces and therefore on the military's required capabilities in space. National and DoD-level guidance is found in the National Security Strategy, the National Military Strategy, the National Space Policy, and the National Security Space Master Plan. Joint Space Guidance is found in Joint Vision 2010, the USSPACECOM Vision 2020 and the USSPACECOM Long Range Plan (LRP).

National and DoD Space Guidance

National and DoD space guidance establishes comprehensive parameters for US interests and equities in space. As a body, it provides for a strong enduring US presence in space. It calls for US leadership and emphasizes the nation's determination to maintain free access to the use of space, and (in concert with other friendly states) to deter aggression in space.

The National Security Strategy (NSS)

The NSS establishes the nation's security goals and describes how the full weight of national power, to include the military, will be used to attain these goals. Concerning space, the NSS states that the US must:

- Maintain its leadership position;
- Preserve uninhibited access;
- Deter threats and defeat hostile efforts against US space assets;
- Prevent the spread of weapons of mass destruction; and
- Enhance global partnerships with space-faring nations.

The National Military Strategy (NMS)

The NMS identifies US national military objectives, provides a strategy to achieve those objectives, and recommends a force to execute that strategy. The NMS reinforces the imperatives for space listed in the NSS and additionally establishes "space control" (the ability of friendly forces to ensure freedom of action in space and to deny such freedom to adversaries) as a "key enabler" of present and future US military operations.

The National Space Policy (NSP)

The NSP provides the goals and objectives of the US Space Program. The NSP reinforces and expands on the goals and missions for space provided in the NSS and the NMS. A full summary of the current NSP is contained in Chapter 2.

The National Security Space Master Plan (NSSMP)

The NSSMP provides a common national vision for space circa 2020. It contains DoD guidance for the management of space programs—to include guidelines for transitioning these programs from the FYDP to future years. Additional information concerning the current NSSMP is contained in Chapter 2.

Joint Space Guidance

The Joint guidance discussed below provides CJCS and USCINCSPACE instructions to the services and the joint commands for fulfilling their responsibilities in future joint space warfighting concepts.

Joint Vision 2010 (JV 2010)

JV 2010 provides a template for joint operations in the 21st century and guidelines for use in the development of supporting service visions and future warfighting concepts. JV 2010 introduces a new focus on "Full Spectrum Dominance" (the ability of US forces to fight and win at all points on the Spectrum of Crisis). Full Spectrum Dominance depends on two key enablers: information superiority and technological innovation—both of which are dependent on space-based systems. JV 2010 also introduces four operational concepts: Dominant Maneuver, Precision Engagement, Focused Logistics, and Full-Dimensional Protection. JV 2010 is particularly important in the development of space requirements because it emphasizes *the firm connection between the nation's ability to exploit its space capabilities and the ability to achieve and maintain information superiority on future battlefields.*

The USSPACECOM Vision for 2020

This document provides USCINCSPACE's vision of the future space environment and his/her guidelines for developing strategies to implement that vision. The document's principal themes focus on the need to "dominate" the medium of space and to integrate space power throughout all military operations. In this document, USCINCSPACE introduces four operational concepts: Control of Space, Global Engagement, Full Force Integration, and Global Partnerships. These concepts were addressed in Chapter 1.

The USSPACECOM Long Range Plan

This document contains a methodology to execute USCINCSPACE's four operational concepts. It provides the joint community with a detailed roadmap for use in developing space capabilities for the 21st Century. It is an essential tool for ensuring the proper synchronization of requirements with desired future joint space warfighting capabilities.

The challenge facing the Army is to interpret National, DoD, and Joint guidance for space, to continually enhance its own space warfighting concept, and to generate space requirements that will result in the capabilities needed to support both the national space strategy and future joint warfighting concepts. The remainder of this chapter discusses how the Army is meeting that challenge.

Space Requirements Coordination and Integration

The TRADOC commander reviews and approves all Army requirements prior to their submission to HQDA for approval. In February 1997, an MOA was signed between CG TRADOC and CG SSDC (since re-designated SMDC) that addressed how space requirements would be determined. The integration concept described in the MOA is depicted in Figure 3-1, which shows the relationship between CG TRADOC, CG SMDC, and the TRADOC branch proponents in the

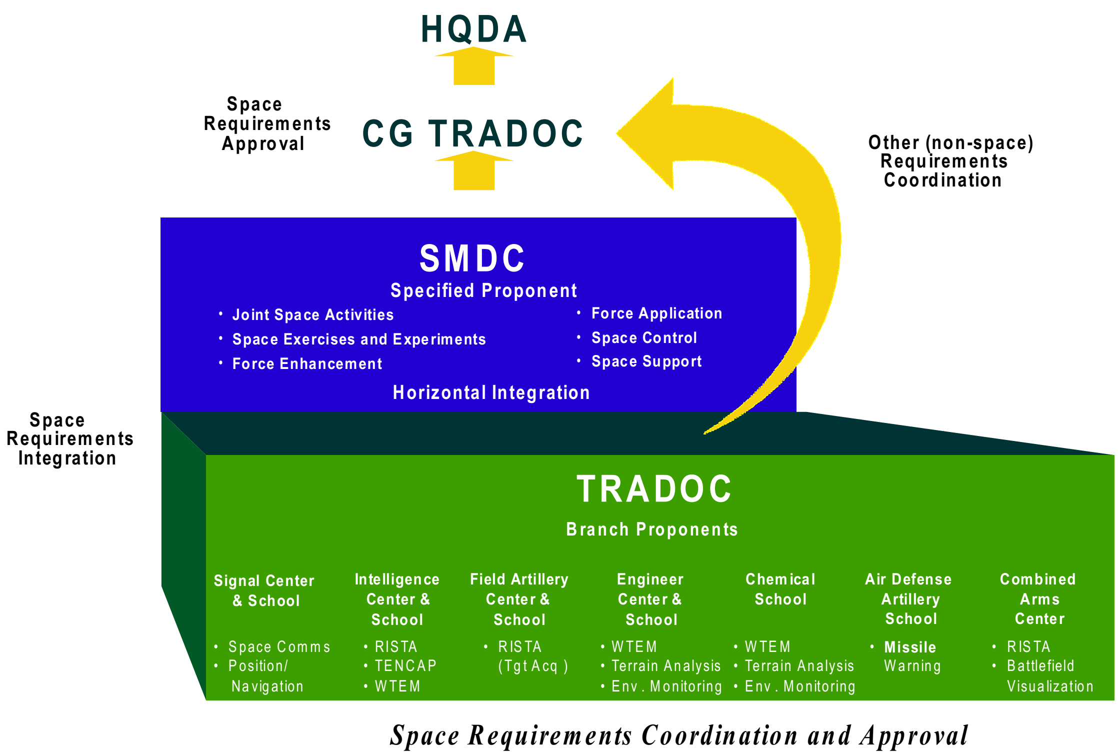


Figure 3-1: Army Space Requirements Integration and Coordination

integration and coordination of space requirements. SMDC was placed in a unique position to influence joint space requirements and to help ensure that Army space requirements are synchronized and integrated both horizontally and vertically.

The MOA designated SMDC as the specified proponent for space and National Missile Defense (NMD). It also established SMDC as the horizontal integrator for Theater Missile Defense (TMD) and assigned SMDC full responsibility for NMD DTLOMS requirements generation. The MOA was designed to improve the synchronization and prioritization of space resources. SMDC was:

- Designated the Army's specified proponent for space with specific proponency for joint space activities, space exercises and experiments, and for the four space mission areas (Force Enhancement, Force Application, Space Control, and Space Support);

- Made responsible for the horizontal integration, review, and oversight of space-related aspects within the following functional areas for which branch proponency is at TRADOC schools: Communications; Position and Navigation; Reconnaissance, Intelligence, Surveillance, and Target Acquisition (RISTA); Weather, Terrain, and Environmental Monitoring (WTEM); and Missile Warning;

- Given responsibility to lead Army space requirements generation; and

- Made responsible for developing overarching space concepts and doctrine.

Army Participation in Joint Space Requirements Determination

As the Army's specified proponent for joint space activities, SMDC assists USSPACECOM and other joint commands to ensure that joint space requirements are documented, coordinated, and integrated. The CG, SMDC is also dual hatted as CG, Army Space Command (USARSPACE) component commander for USSPACECOM. Acting through USARSPACE, SMDC is active in joint requirements determination through its participation in the USSPACECOM Space Planning and Requirements System (SPRS). SPRS is USSPACECOM's process for recommending solutions to satisfy future space requirements. SMDC provides USSPACECOM with:

- DTLOMS assessments;
- Insights into Army experimentation and analysis; and
- Reviews and comments pertaining to Joint requirements documents.

In coordination with SMDC, USARSPACE provides input to the annual review of the USSPACECOM Vision and helps collect, review, and consolidate current and emerging needs that can be satisfied through space capabilities.

CG SMDC's specific guidance on how the Army must influence Joint requirements in the future is provided in Figure 3-2.

Figure 3-2: Army Participation in Joint Space Requirements Determination

The Army Space Requirements Determination Process

TRADOC Pam 71-9 provides the overarching requirements determination process used throughout the Army. This process addresses requirements determination from a capabilities/needs perspective instead of the traditional threat-based perspective used during the Cold War and focuses on requirements from a balanced DTLOMS viewpoint rather than focusing solely on materiel solutions. SMDC has adapted TRADOC's requirements process to the space environment and will employ an Integrated Concept Team (ICT) to oversee the determination of space requirements and to ensure horizontal integration. The Space ICT will play a pivotal role in determining warfighting requirements across the DTLOMS domains and in directing the preparation of DTLOMS requirements documentation necessary to attain future capabilities. The SMDC model is depicted in Figure 3-3.

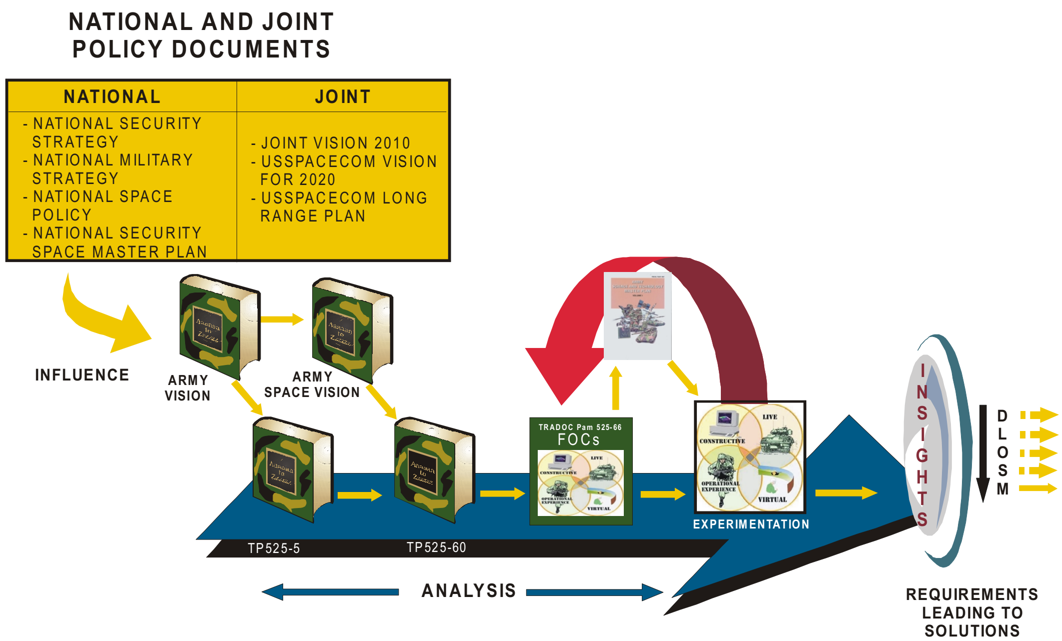


Figure 3-3: The Space Requirements Determination Process

While presented in a sequential manner (primarily for explanatory purposes), it must be emphasized that the requirements determination procedures detailed below are primarily meant to discipline the space requirements determination process rather than to place it in a restrictive linear continuum. In practice, the generation of space requirements is extremely dynamic and fluid. Innovative thinking and creative solutions, which lead to enhanced capabilities, in a timely manner, and at reduced costs, are highly encouraged.

The Space Requirements Determination Process

Step 1

CG, TRADOC develops the Army's future warfighting vision based on national and joint guidance, that provides overarching organizational and operational imperatives for the future Army.

Step 2

Development of an Army Space Vision that provides a broad overview and assessment of how space capabilities can best enable and enhance the Army's goals.

Step 3

Approval of a CAPSTONE Warfighting Document that provides TRADOC's conceptual views of future operations in war and in operations other-than-war and which guides the development of the space warfighting concept.

Step 4

Approval of a Space Warfighting Concept that provides a detailed analysis of how space capabilities and systems can support the TRADOC CAPSTONE warfighting concept, and which drives the development of FOCs and space-related experimentation and analysis.

Step 5

Development and approval of Future Operational Capabilities (FOCs) for Space. FOCs address capabilities considered essential in implementing future warfighting concepts. They provide a control element in the requirements determination process by guiding science and technology initiatives, space-related research, development, and experimentation.

Step 6

Conduct of space-oriented experimentation and analysis based on approved FOCs (and influenced by ongoing Army Science and Technology objectives). These initiatives provide the opportunity to determine and refine requirements through stringent test and evaluation procedures that yield valuable insights concerning DTLOMS solutions.

Step 7

Determination of Space Requirements based on specific DTLOMS initiatives and solutions.

The Status of Army Space Requirements Determination

This section of chapter 3 tracks the current status of Army space requirements documentation-in particular, the development of the current approved Army Space Warfighting Concept and its supporting FOCs. It does this by following the Army space requirements determination process described in the last section. It should be noted that while great progress has been made in institutionalizing the TRADOC-SMDC requirements methodology, connectivity between documents and activities is not yet complete. (For example, the current Army CAPSTONE Concept and the current space warfighting concept are being revised.) *Nevertheless, while the system is immature, it is functioning. Serviceable (and in some cases excellent) requirements documents are presently available. Space FOCs have been developed. Important space-related experimentation and analysis is underway. Most importantly, space requirements are being developed within DTLOMS.*

Step1. Development of an Army warfighting vision, based on national and joint guidance, that provides overarching organizational and operational imperatives for the future Army.

The Army Vision

To adjust the condition of the Army to better meet the requirements of the next century, the Army's Vision forms an overarching goal to frame Army transformation initiatives. The Army

Vision is articulated as follows: *"Soldiers on point for the Nation transforming this, the most respected Army in the world, into a strategically responsive force that is dominant across the full spectrum of operations."* Realization of this vision will allow the Army to provide the nation an array of deployable, agile, versatile, lethal, survivable, and sustainable formations, which are affordable and capable of reversing the conditions of human suffering rapidly and resolving conflicts decisively.

Space capabilities and products are essential to develop the specified attributes of our transforming Army. Strategic responsiveness is enhanced by the availability of spaced-based systems to provide and uninterrupted flow of information. Satellites will enable or provide surveillance capabilities, real time intelligence, global secure communications, position and navigation data, and the weather, terrain, and environmental data necessary to ensure a rapid and smooth flow of forces into the theater of operations, and thereby enhancing the Army's deployability. Situational awareness is maximized by the use of spaced-based systems, and facilitates the mental and physical agility of the force. The ability of our organizational structures to generate formations that can dominate at any point on the spectrum of operations, that is, the force's versatility, is significantly enhanced by information made available by space-based systems. Assured communications, total situational awareness, and horizontal and vertical integration of effort, all garnered from space-based systems, are needed to coalesce the elements of lethal combat power. Space-based systems make possible the Intelligence Preparation of the Battlespace (IPB) necessary for the development and maintenance of force protection activities leading to force survivability. Sustainability of forces is that information is secured from space-based systems. Thus, the ability of the Army to realize its Vision of a strategically responsive force that is dominant across the full spectrum of operations is inextricably linked to the capabilities and products provided by space-based systems.

Army formations will execute their joint responsibilities through a deliberate set of operational patterns that serve to focus the tasks the army must accomplish to be successful. As a companion document to JV 2010, Army Vision 2010 articulated Army roles and patterns of operation within the framework established by the Joint Vision and provided an abstract of future warfighting capabilities that was universally accepted within the Army. The patterns are: Project the Force, Protect the Force, Shape the Battlespace, Decisive Operations, Sustain the Force, and Gain Information Dominance. These patterns of operations and the force descriptors of the Army Vision are fully supportive of the operational concepts contained in JV 2010. Figure 3-4 illustrates the linkages between JV 2010 and the end state articulated in the Army Vision.

The Army Vision is important to the development of space requirements for a number of reasons. First, it establishes a clear end state for the transformation of the current force. Second, it lays the foundation for translating the JV 2010 operational concepts into concepts supporting the nation's full spectrum force of choice. Third, and most importantly, the Army Vision provides the framework

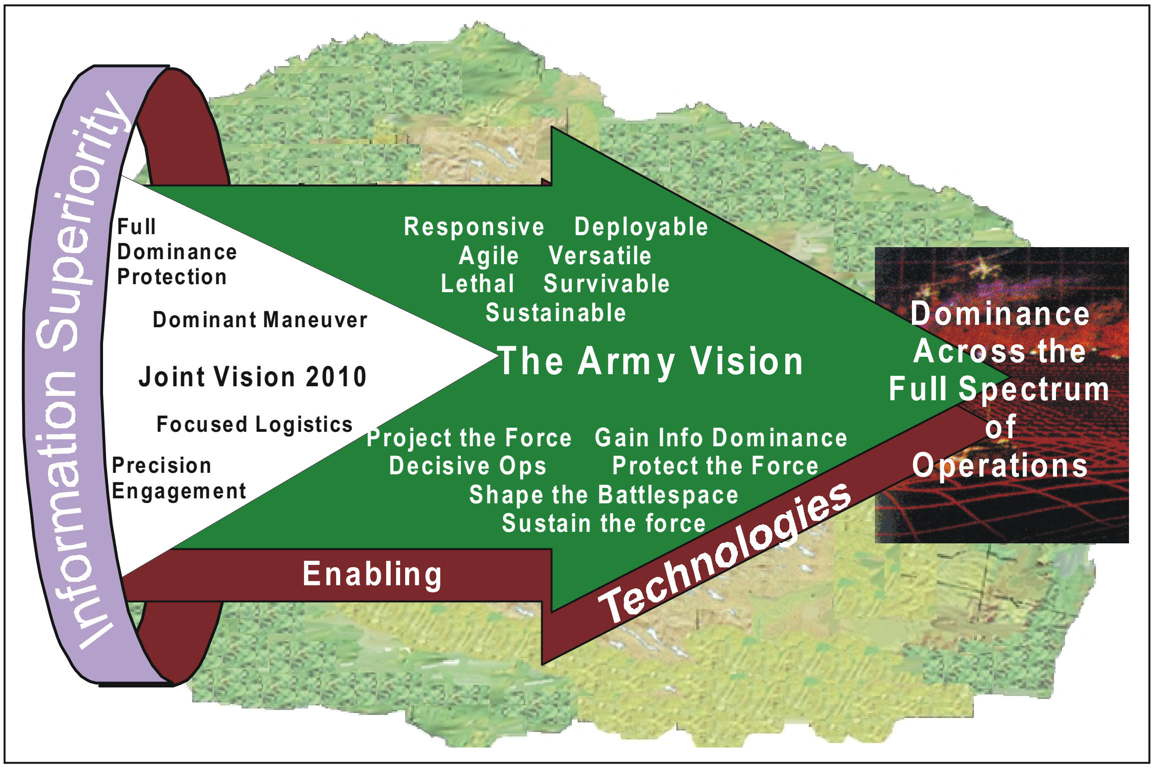


Figure 3-4: Army Vision 2010 and Joint Vision 2010

for identifying clear linkages between the exploitation of space and the warfighter's ability to dominate across the full spectrum of operations. As the Army transforms and develops new organizational designs and equipment sets, requirements for space-based support will continue to evolve. Forums, processes, and procedures are in place to facilitate changing requirements.

Space Capabilities in Army Operations

Space operations have been identified as essential enablers to land-based warfare. Space's central role in future warfare is to enable fused inputs for manned and unmanned sensors (including satellites) providing unprecedented battlefield situational understanding well beyond the horizon. Thus, there is a critical linkage between space, information provided by space systems, and success in future engagements across the full spectrum of operations.

Step 2. Development of a Space Vision that provides a broad overview and assessment of how space capabilities can best enable and enhance the Army Vision.

SMDC Vision 2010

SMDC Vision 2010 was published on 1 October 1997. It is the tool by which the CG, SMDC articulates an organizational approach for integrating Army space activities and operationalizing space in support of the warfighter. While it is not an Army Space Vision, this document is useful in the development of space requirements because it specifically defines the contributions that space systems can make to realize the goals of the Army Vision (see Figure 3-5).

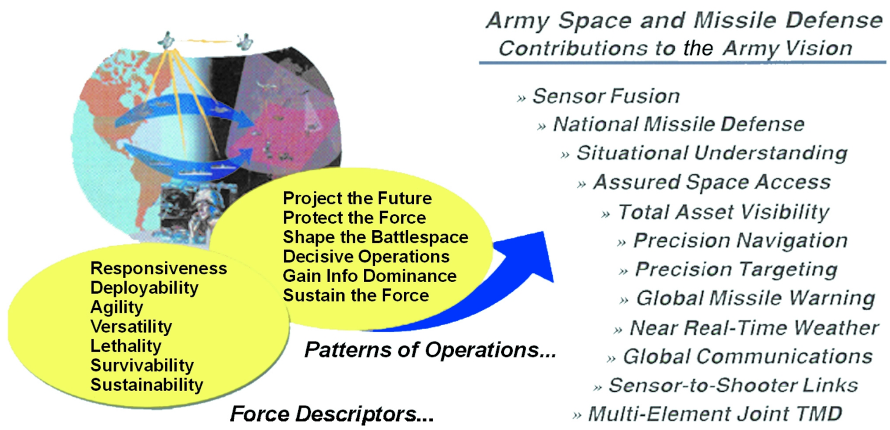


Figure 3-5: Army Space and Missile Defense Contributions to the Army Vision

Step 3. Approval of a CAPSTONE Warfighting Document that provides TRADOC's conceptual views of future operations in war and in operations other than war and which guides the development of the space warfighting concept.

TRADOC Pam 525-5 (Force XXI Operations)

TRADOC Pam 525-5 is CG, TRADOC's CAPSTONE warfighting concept. This document provides an insight of warfighting capabilities 3-15 years into the future. It is the primary guide used to develop the Space Warfighting Concept (TRADOC Pam 525-60). It provides the conceptual foundation for the conduct of operations involving the US Army in the early twenty-first century. While the ideas and terminology in TRADOC Pam 525-5 have been refined since its publication, the document still provides a valuable tool in helping to conceptualize the future. It describes future force characteristics and battle dynamics.

TRADOC Pam 525-5 assigns space-based systems a significant role in the distribution and safeguarding of information. It states "satellites will be vital in passing intelligence, data, etc., over great distances. Space systems will provide surveillance, communications, weather, environmental contamination and terrain data, and positioning and targeting capabilities that will give tactical commanders at all levels a comprehensive knowledge of the battlefield." It further establishes the importance of space by listing three areas of space-related technology that are critical to future warfighting. These include: threats to military information systems; jamming threats to satellites used by US forces; and sensor technologies. Finally, TRADOC Pam 525-5 establishes specific warfighting requirements that are dependent on space capabilities:

- Possession of electronic warfare protection features, anti-satellite capabilities, and amplified electronic warfare attack and protection systems.

- Assessment of enemy strength, location and movement over wide areas.

- Coordination of forces over great distances.
- Accurate positioning of friendly ground forces.
- Acquisition of deep targets.

Step 4. Approval of a Space Warfighting Concept that provides a detailed analysis of how space capabilities and systems can support the TRADOC CAPSTONE warfighting concept, and which drives the development of FOCs and space-related experimentation and analysis.

TRADOC Pam 525-60 (Space Support to Land Force Operations)

TRADOC Pam 525-60 provides the current TRADOC-approved warfighting concept for space. This document was published in 1994. It will be revised in the near future. The current concept, however, provides a credible template for determining space requirements. Four aspects of TRADOC Pam 525-60 are emphasized below due to their influence on space requirements definition. They include:

- The space mission areas.
- The current Army space concept.
- The Army's long term strategy for space.
- The Army's desired capabilities for space.

The Space Mission Areas

TRADOC Pam 525-60 divides space system capabilities into four space mission areas and defines these areas as shown below. Since the publication of this Pamphlet, considerable effort has been focused on refining the definitions of the mission areas. While the definitions that follow are current and approved, they will be updated as the Army space warfighting concept is revised.

Force Enhancement

Force Enhancement is defined as "any operation conducted from space with the objective of enhancing, enabling, or supporting terrestrial operations in peacetime, conflict and war." Force Enhancement includes (but is not limited to) communications, navigation, weather, terrain, environmental monitoring, missile warning, and ISR support. The Army's involvement is largest in this mission area.

Force Application

Force Application addresses the conduct of combat operations from, in, or through space with the intent to destroy terrestrial targets. It consists of offensive and defensive operations to use space and space capabilities to project power. Consistent with treaty obligations, Force Application could include the use of space-based and ground-based systems to provide protection from ballistic missiles.

Space Control

Space Control addresses the ability to ensure freedom of action in space for friendly forces while limiting or denying enemy freedom of action in space. It consists of offensive operations to gain space supremacy and defensive operations to ensure the survivability of friendly space systems.

Space Support

Space Support addresses the military infrastructure needed to launch and deploy space systems (launching, maintaining telemetry, tracking, commanding, recovering, and providing logistics support).

The Army Space Concept

The Army Space Concept, in a sentence, is "to use space systems and capabilities to enhance the Army's ability to execute force projection operations doctrine." *This concept statement provides for comprehensive requirements definition within the area of Force Enhancement, but offers less guidance in developing requirements that support the Army's growing interest in operations in, to, and from space itself (Space Control and Force Application).*

The Army integrates space and ground operations presently through the use of ground terminals. Most space systems were designed for strategic rather than operational or tactical support. Existing systems require that data be processed prior to its dissemination to units. Over time, direct satellite-to-user linkages will evolve. In the near-term, the Army will exploit currently deployed space capabilities. By 2010 (mid-term), the Army will acquire processors that will provide more direct interface with space systems. The Army will operate lightweight mobile ground-based processors that will integrate and display information critical to winning the ground battle. By 2025 (far-term), the Army will influence space systems that have been designed to meet its specific requirements. Army users will be provided a direct link with supporting space systems. This link will enable both direct tasking and direct downlink of sensor data. Space platforms will link finished products to the ground force. Data from supporting systems will be processed, collated, and disseminated simultaneously from space to users on the ground.

The Army's Approved Capabilities for Space

Table 3-1 contains information taken from TRADOC Pam 525-60 and provides valuable guidelines concerning the Army's "approved" needs for space capabilities. These capabilities primarily address Force Enhancement and have driven a series of FOCs that stress space support to the Ground Commander. The Army's interests in space have expanded to include Space Control and Force Application. Future versions of TRADOC Pam 525-60 must reinforce these interests and lead to the development of additional Space FOCs.

<table>
<tr><th rowspan="2">Mission</th><th colspan="2">Required Capabilities</th></tr>
<tr><th>NEAR TERM (00-05)</th><th>MID TERM (06-11)
FAR TERM (12-20)</th></tr>
<tr><td>Mobilization, Pre-deployment, and Demobilization</td><td>NEAR TERM
• Global indications and warning
• Global situational awareness
• Mapping and imagery
• Meteorology and Environmental monitoring
• Logistical capabilities (split-based logistics; in-transit visibility; Total Asset Visibility; Global Transportation Network)</td><td>FAR TERM
• Data processed, collated and disseminated simultaneously from space to multiple users</td></tr>
<tr><td>Deployment</td><td>NEAR TERM
• Global connectivity
• Global surveillance
• Real and near-real time intelligence
• positioning, navigation, and timing data
• Information to support enroute mission planning and rehearsals
• Split-based operations</td><td>MID-FAR TERM
• Communications, observation, and imaging satellites compatible with other civil, military, commercial, and national systems
• Smaller, lightweight, reliable, interoperable ground-based systems
• Spare technology embedded with terrestrial system</td></tr>
<tr><td>Entry Operations and Operations</td><td>NEAR TERM
• Processing terminals
• Global connectivity
• Real and near-real time intelligence
• Position, navigation, and timing data
• Surveillance, warning, and remote sensing
• Multispectral and hyperspectral imagery
• Battle Damage Assessment</td><td>MID TERM
• Sensor to shooter linkages
• Real time friendly and enemy locations
• Digitized dissemination of data

FAR TERM
• Space-based processing
• Position and Navigation capabilities</td></tr>
<tr><td>War Termination and Post Conflict Operations</td><td>NEAR TERM
• Information to support command and control, prisoner control, refugee handling, minefield detection, ordnance detection, humanitarian and civil assistance activities</td><td></td></tr>
<tr><td>Redeployment and Reconstitution</td><td>NEAR TERM
• Asset visibility to decrease the logistic pipeline
• Satellite assisted maintenance and telemedicine
• Information to support casualty reporting, BDA, asset location</td><td></td></tr>
<tr><td>Operations other than War</td><td>NEAR TERM
• SATCOM infrastructure
• Weather, terrain, and environmental monitoring
• Mapping, charting, and geodesy
• Positioning, navigation, and timing</td><td></td></tr>
</table>

Table 3-1: Approved Capabilities for Space

Step 5. Development and approval of Future Operational Capabilities (FOCs) for Space. FOCs are the control element in the Requirements Determination Process and guide science and technology objectives, research and development, and experimentation.

The Future Operational Capabilities (FOCs) for Space

FOCs are, by definition, "statements of operational capability desired by the Army to achieve the goals stated in the approved warfighting concepts of operation (TRADOC Pam 525 series)." They form the basis for determining requirements in the DTLOMS domains, and for defining and refining requirements. All warfighting requirements must be linked through an FOC to an approved warfighting concept. The FOCs for space, all traceable to TRADOC Pam 525-60 (Space Support to Land Operations), are listed below. Detailed descriptions are provided in Annex C.

- SP 97-001. Space Sensors Linked With Terrestrial Systems
- SP 97-002. Passive and Active Target Detection and Processing
- SP 97-004. Support Battle Damage Assessment
- SP 97-005. Space Simulation and Modeling Tools
- SP 97-007. Interoperability

- SP 97-008. Responsive and Reliable Network Architecture
- SP 97-009. Real Time Prioritized Information Dissemination
- SP 97-011. Standardization of Battlespace Data
- SP 97-012. Survivable Systems with Low Probability of Intercept
- SP 97-014. Collection and Dissemination of Mapping, Charting, and Geodesy Data
- SP 97-015. Collection and Dissemination of Targeting Data (All Sources)
- SP 97-016. Automatic/Aided Target Recognition (ATR)
- SP 97-017. Continuous and Global Satellite Coverage
- SP 97-018. Army Space Qualified Personnel
- SP 97-019. Army Support for Modular Satellite Construction
- SP 97-020. Theater Missile Defense
- SP 97-021. Offensive Space Control

Science and Technology (S&T)

FOCs help guide the Army's Space S&T activities and industry research and development. As a result of these activities, S&T initiatives relevant to both approved and emerging FOCs are developed and integrated into Space-oriented Experimentation and Analysis (and when possible into Army warfighting experiments and Army and Joint exercises). The S&T process is particularly important in the nomination of space-related candidates for the Army's Science and Technology Objective Review Process and in determining appropriate Advanced Technology Demonstrations.

Step 6. Conduct Space-oriented Experimentation and Analysis based on approved FOCs. These initiatives provide the opportunity to determine and refine requirements through stringent test and evaluation procedures, and yield possible DTLOMS solutions.

Space-related Experimentation and Analysis

Concepts, emerging technologies, and materiel initiatives with the potential to satisfy or partially satisfy the Space FOCs are continually generated by sources throughout the Army and industry. The TRADOC Battle Laboratories—and particularly the Space and Missile Defense Battle Laboratory in Huntsville, Alabama and Colorado Springs, Colorado—are responsible for assessing the military usefulness and potential of these initiatives. They do this by planning and conducting detailed experiments. These experiments are key to the requirements determination process. They result in critical insights that lead in turn to potential space requirements—i.e., recommended changes in DTLOMS. At present, numerous space-related initiatives based on the Space FOCs are being conducted throughout the Army under the direction of the Battle Laboratories. Key initiatives within the areas of experimentation, demonstrations, modeling and simulation, and studies and analysis are discussed in Chapter 6.

Step 7. Determination of Space Requirements based on specific DTLOMS initiatives and solutions.

Documenting DTLOMS Initiatives for Space

It is SMDC's responsibility, as proponent for space, to ensure that the insights and the recommendations for changes within DTLOMS that are generated through the Experimentation and Analysis process are properly documented. Under direction of the Space ICT, requirements documentation will be prepared and, when appropriate, forwarded to CG TRADOC for approval and resourcing. Requirements documentation by DTLOMS domain is as follows:

- Doctrine: Changes or additions to space doctrine that reflect current Army and Joint Warfighting concepts
- Training: Individual Training Plans, Course Administration Data, and Programs of Instruction that will result in necessary changes in the development and execution of training programs critical to the advancement of Space Literacy.
- Leader Development: Memoranda leading to changes in the educational process whereby leaders acquire the skills and knowledge necessary to ensure that space capabilities are properly exploited in support of Army operations.
- Organizations: Unit Reference Sheets or Changes to Tables of Organization and Equipment related to the improvement or design of space-related organizational structures.
- Materiel: Mission Needs Statements (MNS) and Operational Requirements Documents (ORDs) that articulate changes or additions to the systems that enable space operations. These activities may range from modernizing or replacing existing systems to the development of new systems.
- Soldier: Changes or additions to MOS supporting space operations—ranging from modifications in current MOSs that support space operations to the design of a new MOS for space.

Current initiatives within the DTLOMS requirements documentation process are provided in Chapter 4 (non-materiel initiatives) and in Chapter 5 (materiel initiatives).

Future Space Requirements

The Army is evolving from a threat-oriented force designed to win the Cold War into a capabilities-oriented force able to dominate the entire spectrum of crisis in the 21st Century. Given the state of modern weaponry and the pace of technological change, the Army will face adversaries who are extremely capable and dangerous during this period of evolution. To maintain the combat overmatch that it currently exercises against potential opponents, the Army must leverage technology to the fullest extent to increase its combat capability. The effective integration of space-based technology and space systems is a large part of this leveraging process.

Due to lessons learned during the Gulf War, the Army is changing the way it views space. During that conflict, space systems proved, for the first time in history, to be effective combat multipliers at the operational and tactical levels. Space systems provided essential communications and intelligence information as well as timely support to navigation and mapping, surveillance, and weather, terrain, and environmental monitoring.

In the years since the Gulf War, the Army has developed a more complete understanding of the potential payoff of space systems. The Army is now incorporating space into its emerging doctrine and its technical developments. The Army must not become inevitably “drawn into” space; rather, it must become proactive and anticipate future capabilities which space provides. It is expected that Army interests (and future space concepts) will be more concerned with Space Control and even Force Application capabilities.

Space will be an essential enabler of the Army’s warfighting doctrine for the 21st Century. By 2010, space and ground operations will be more fully integrated. Ground operations will be dependent on space systems for the information and connectivity required to conduct successful campaigns. All of the force enhancement services and products noted in the previous paragraphs will be required in 2010, but they will be needed faster, in more detail, and must be available to more tactical leaders on the ground. Commanders will routinely include space operations in their planning sequence. By 2010, since potential adversaries may be able to target US forces from space and to interfere with or even destroy US space systems, considerable emphasis will be placed on Space Control. By 2010, USSPACECOM will be able to better detect, identify, and track both friendly and enemy space-based systems through a worldwide network of radar and optical trackers. Space systems will be available to disrupt, jam, and blind enemy space and ground-based sensors and communications links.

In the longer term, circa 2025, space may become a unique theater of war under the control of a CINC in which combat power will be projected both in space and from space. Space operations may include Force Application—the conduct of combat operations in and through space with the intention of destroying targets on the ground—as much as Force Enhancement and Space Control.

By 2025, operations in space may become a reality. Defensive space systems will be available to acquire, identify, track, and target other space platforms. Offensive space weapons systems will disrupt or destroy enemy space platforms. Space-to-surface warfare will have become feasible as space sensors acquire and target high payoff terrestrial systems and facilities. Recent wargame experience indicates that by 2025 the Army must be capable of supporting combat operations in space if it is to operate successfully on Earth.

Summary

Within the past ten years, The Army has made great strides in articulating the role of space in 21st Century warfighting. Significant strides have been made in:

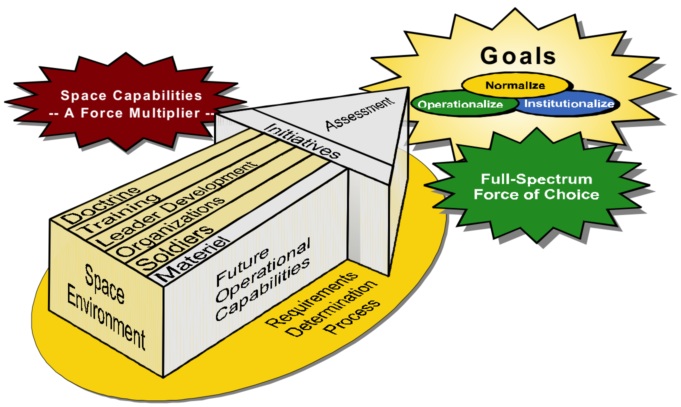
- **How the Army Organizes for Space.** SMDC has been designated the Army's proponent for space, and is instituting procedures and policies to better integrate service initiatives into space system operational architectures. This organizational initiative will, over time, ensure the better integration of space activities within the Army, lead to better utilization of all service resources allocated for space, and give the Army a stronger voice in the DoD and Joint space arenas.

- **How Space Warfighting Concepts are Developed.** The initial concepts for future space support to the warfighter were promulgated in a series of documents, to include TRADOC Pamphlets 525-5 and 525-60 which established an inseparable connection between space systems and information required by commanders. These concepts are now being updated and expanded. While the current approved documents are satisfactory in the mission area of Force Enhancement, future space warfighting concepts will no doubt help expand Army equities in space.

- **How Space Requirements are Determined, Integrated, and Approved.** The Army has taken measures to institutionalize a capabilities-based requirements determination process. While still immature, this process will institutionalize an effective iterative procedure that provides appropriate discipline without sacrificing innovation and initiative.

Chapter 4: Non-Materiel Activities

DTLOS plays a critical role in satisfying Future Operational Capabilities.



Introduction

This chapter identifies current and planned non-materiel activities and initiatives within the Doctrine, Training, Leader Development, Organizations, and Soldiers (DTLOS) domains that support Army efforts to operationalize, institutionalize, and normalize space. These initiatives will result in near term progress to achieve space capabilities that support future operational warfighting concepts. The chapter addresses:

- The role of non-materiel (DTLOS) solutions in pursuing future operational capabilities (FOCs) for space.

- Doctrine initiatives to integrate space operations throughout Army and Joint doctrinal publications (concepts, doctrinal manuals, and tactics, techniques, and procedures manuals).

- Training initiatives that affect space-related activities within the Army's training and professional development programs, ranging from institutional training conducted in TRADOC schools to individual and collective training conducted in operational units.

- Leader Development initiatives which emphasize space education, literacy, and training and enhance the ability of leaders to operationalize, institutionalize, and normalize space activities into Army operations.

- Organizational initiatives that affect the equipment and organizational structures required to fully exploit space in the Army.

- Initiatives affecting soldiers, particularly advances in the Military Occupational Specialty (MOS) structure, which broaden the Army's ability to integrate space capabilities.
- The role of non-materiel (DTLOS) solutions in pursuing future operational capabilities (FOCs) for space.
- Linkages between on-going DTLOS activities and the current Space FOCs.

DTLOS Non-Materiel Domains

Chapter 3 detailed the process used by the Army, under the direction of Space and Missile Defense Command (SMDC), to determine how requirements will be generated to support and enable the Army's future warfighting concept. That process has resulted in seventeen approved space FOCs—statements of operational capability—which are presently giving direction to S&T research, space-related experimentation, and the development of requirements, e.g., changes in DTLOMS structure. The space FOCs are presented in detail in Annex C.

This chapter addresses current and planned initiatives in the non-materiel DTLOS domains that will help the Army achieve the space FOCs. The Army is committed to attaining the desired capabilities in space and obtaining information from space platforms/ payloads in the most timely and cost-effective manner possible. Therefore, the Army intends to seek solutions in the non-materiel DTLOS domains before it opts for more expensive and slower materiel solutions. It looks at attaining capabilities through changes in Doctrine—the easiest changes to effect—then through changes in Training, Leader Development, Organizational Design, Personnel (Soldier) Management, and finally through changes in Materiel. The initiatives within the non-materiel DTLOS domains are described below:

- **Doctrine** refers to the fundamental principles that guide military forces. With respect to space, Doctrine must ensure that space operations are embedded not unlike Battlefield Operating Systems in *all* Army doctrinal and conceptual documents as well as fully integrated with the mediums of terrestrial operations (land, sea and air). Space doctrine must help the Army to fight as a member of a joint force and to conduct space operations to enhance land operations. Current initiatives address important changes that will update and enhance the critical documents that guide and give direction to Army space operations. These initiatives include revisions to the Army space operational concept as well as changes to a number of Field Manuals, Joint pamphlets, and TRADOC pamphlets that guide operations in space.
- **Training** refers to the processes whereby soldiers and units develop individual and collective skills in operating items of equipment or systems. Although space support is increasingly essential to land operations, soldiers often do not have a full understanding of how space systems and products enhance land operations. The Army must operationalize, normalize, and institutionalize space to the degree that leaders and soldiers fully understand

and appreciate the impact of space on Army operations. Current initiatives include the expansion of space-based instruction in Army schooling and field exercises.

- **Leader Development** refers to the continuous process by which the Army's leaders and future leaders acquire the skills and knowledge necessary to guide and direct their subordinates. To be fully competent, today's leaders must understand the impact and role of space systems on the force. Incorporating space systems into operational planning will soon become a core competency for the warfighter. Leader Development initiatives for space must address means by which the Army can develop a cadre of trained leaders who can integrate space activities into Army operations. Leader Development focuses specifically on senior leader education programs, on the development of the Functional Area (FA) 40 (Space Operations) career specialty, and on the 3Y (Space Activities) Additional Skill Identifier (ASI).

- **Organization(al)** initiatives reflect efforts to change or add units, organizations, agencies and equipment to the Army structure. It also refers to organizational relationships and partnerships among the civil, military, and commercial communities. Current organizational initiatives within the space community include the continuing development and maturation of SMDC as well as planning which will lead to the presence of space expertise within Land Component Commander and at the operational/tactical headquarters.

- **Soldier** initiatives address changes in the Army's MOS structure. For space, soldier initiatives will lead either to increases in the numbers of soldiers in functional MOSs who are space literate and proficient in the operation of space systems and products or to the initiation of new space-oriented MOSs.

The next five sections of this chapter provide details on each of these non-materiel domains.

Doctrine

Never static, always dynamic, doctrine is firmly rooted in the realities of current capabilities. At the same time, it reaches out with a measure of confidence to the future. Doctrine captures the lessons of past wars, reflects the nature of war and conflict in its own time, and anticipates the intellectual and technological developments that will bring victory now and in the future.

Space has become an integral component in the Army's technological and operational evolution. In the future, space capabilities and products will be even more critical in the prosecution of land operations. Access to national, civil, allied, and commercial capabilities will be prerequisites for success. The full exploitation of space systems and space products will be essential if the Army is to meet its goals of improved strategic responsiveness and enhanced capability for full spectrum operations.

Doctrine which addresses the overarching principles of space operations and which explains the methodology by which such systems are to be integrated into the Army's operational continuum must be expanded and upgraded to reflect the Army's expanded interests. All applicable Army doctrine must be revisited and adjusted, over time, to include space operations.

There are a number of initiatives underway within the Doctrine domain that will greatly facilitate the Army's ability to conduct space operations. DTLOMS lessons learned from major Army and Joint exercises and previous experimentation and conceptual insights gleaned from Army and Joint wargames will be reflected in the conceptual and doctrinal initiatives. A detailed list of these initiatives is provided in Table 4-1.

Publication	Title/Date	Proponent	Remarks
TP 525-5	Force XXI Operations/ Aug 94	TRADOC	• Describes the Army's approved capstone warfighting concept and is critical to the development of a revised Army space warfighting concept. • Currently under revision (To Be Published (TBP) Aug 99).
TP 525-60	Space Support to Land Force Operations/ Nov 94	SMDC	• Describes the Army operational warfighting concept for space. • Revisions to this document will address future space capabilities required to support the Army through the 2015 timeframe. It will include new and revised FOCs for space. • Details four space mission areas (force enhancement, force application, space support, space control). • Focus is force enhancement. • Currently under revision (TBP- Oct 99).
TP 525-66	Future Operational Capability/ May 97	TRADOC	• Revised annually. • Currently under revision: will contain 17 Space FOCs.
FM 44-50	Joint Tactical Ground Station Operations/ TBP	SMDC	• SMDC's first doctrinal manual for the Army's deployable theater missile warning system. • Details all aspects of JTAGS employment and deployment. • Will focus on interoperability with theater systems and the Theater Event System. • Multi-service implications, since USN mans 1/2 of JTAGS crews. • Under development (TBP- 2nd Qtr. FY99).
FM 100-5	Army Operations/ June 1993	Combined Arms Center (CAC)	• The Army's keystone warfighting doctrine. • Focuses on campaigns, battles, engagements, and operations other then war. • Addresses the fundamentals of force projection. • Currently under revision (TBP- Oct 00).
FM 100-6	Information Operations/ Aug 96	CAC	• Doctrine and Tactics, Techniques, and Procedures (TTP). • Currently under revision (TBP- 4th Qtr. FY99).

Table 4-1: Doctrine Initiatives

Publication	Title/Date	Proponent	Remarks
FM 100-12	Army Theater Missile Defense Operations/TB	Air Defense Artillery (ADA) School	• New Army TMD doctrine • Under development (TBP- 1st Qtr. FY99)
FM 100-18	Space Support to Army Operations/ July 95	SMDC	• Establishes doctrine for the Army's use of space, enumerates current space capabilities, and provides guidelines for the use and application of space capabilities to support Army operations. • Stresses the Army's "critical dependence" on space assets, capabilities, and products. • Lays out four space mission areas, with emphasis on force enhancement. • Provides information concerning space policies and organizations. • Includes a space operations annex. • Revision/update to begin FY99.
JP 3-13	Joint Doctrine for Information Operations/TBP	Joint Staff (J38)	• New Joint IO doctrine.
JP 3-14	Joint Doctrine; Tactics, Techniques, and Procedures (TTP) for Space Operations/TBP	United States Space Command (USSPACECOM)	• Sets forth doctrine and selected tactics, techniques, and procedures to govern the joint operations as well as military involvement in multinational and interagency operations. • Under development (TBP).

Table 4-1: Doctrine Initiatives (Continued)

Training

Space literacy—the understanding of space capabilities and products and their use in military operations—can best be advanced through a continuum of formal education, training, and field exercises. Tactical training, starting at entry level for both officers and enlisted soldiers, is the foundation of space literacy. As individuals are trained to do their tasks, effective application of space resources will become a normal part of doing business. Providing soldiers with comprehensive space-oriented training is critical if the Army is to fully realize its potential in space. The goal of such training is to develop soldiers of all ranks who understand the application of space operations and who can maximize the potential of space assets. Space training initiatives focus on the integration of:

- Space-related instruction and activities into all aspects of the Army's educational systems—ranging from TRADOC branch schools to unit and individual training programs; and

- Space-related systems, products, and activities into Army training exercises, including war games, models, and simulations.

While not an exhaustive list, the following examples provide an overview of current and future space-related training initiatives.

Space-Oriented Education

Present

Army Intelligence has institutionalized space literacy training and leverages training opportunities offered by other services and national agencies. The Army TENCAP program and the National Systems Development Program (NSDP) administered by the Intelligence and Security Command are two examples. Space-related training is also integrated into the curriculum of the individual TRADOC branch schools in accordance with programs of instruction developed by the branch proponents and approved by TRADOC. Such instruction is branch-unique and focuses most heavily on developing expertise in space enablers to the branch mission. As space systems become more integrated into Army-wide operations, more standardized curricula will be fielded.

Future

Standardized, common core instruction on how to integrate space capabilities into operational planning will be included in all branch Captains Career Course programs of instruction. This instruction will include descriptions of space mission areas and how space capabilities support Army and joint operations. Standardized space capabilities instruction will also be incorporated into the resident and non-resident Command and General Staff Officers Course and the Sergeants Major Course. This will ensure a degree of standardized knowledge throughout the officer corps concerning the capabilities and use of space systems and products. All officers will share a fundamental understanding of the practical functions of space systems at the tactical and operational levels. Officers in all specialties—combat arms, combat support or combat service support—will understand the role of space at the tactical, operational and strategic levels. Similar efforts aimed at non-commissioned officer and enlisted education and training programs are envisioned for the future.

Other initiatives will address space training in combined arms and tactics courses (corps-level and below), intelligence courses, and in advanced intelligence and advanced fire support coordination courses.

Major Exercises

Present

The Army integrates space capabilities and operations into major exercises from theater to division level. These exercises provide an invaluable means for units to develop expertise in the employment of space systems. Significant progress is being made in reaching this goal. US Army Space Support Teams (ARSSTs) provided by Army Space Command (USARSPACE) deploy more than twenty-five times each training year to facilitate space-oriented play in major exercises. A crucial part of the Army TENCAP program is its integration with and participation in exercises—the results of which are fed directly back into the program's development process.

Future

In the future, space operations will continue to play a major role in exercises such as:

- Prairie Warrior
- Roving Sands
- Optic Windmill
- Ulchi Focus Lens

Lessons learned will be incorporated into doctrinal updates (as well as training, tactics, techniques, and procedures) and will be fed into the Army educational process.

Warfighting Experiments

Present

Warfighting experiments are critical to the development of the skills, organizations, and equipment that will be available to the Army in the 21st Century. They are essential in the validation of the future force warfighting concept and the operational concepts in Joint Vision 2010. Experimentation at Corps and division levels is an effective tool for training and assessing the ability of Army leaders to employ their combat, combat support, and combat service support assets to bring decisive force to a theater of operations. They serve as invaluable vehicles for incorporating and testing space-based systems, and for focusing the attention of leaders on the critical elements of space support. Space products and services enable and enhance land operations in a number of ways.

Future

Future experiments and simulations will address DTLOS insights as well as the following capabilities:

- Position, navigation, and timing;
- Space-based communications;
- Weather, terrain, and environmental monitoring (WTEM);
- Reconnaissance, intelligence, surveillance, and target acquisition (RISTA); and
- Missile warning.

Space support to the III Corps Warfighter is currently being finalized. Candidate support areas include:

- Tactical Weather
- Force Warning
- Civil/Commercial Imagery
- Global Broadcast Services
- Low Earth Orbit Communications
- Fire Support
- TTP Development

To accomplish these objectives, the Army is dedicating Battle Lab resources to affect technical advances to simulation tools that replicate space capabilities and limitations.

Joint Experimentation

SECDEF has designated the CINC U.S. Joint Forces Command (JFCOM) as Executive Agent for Joint Experimentation. As such, CINCUSJFCOM will:

- Explore new concepts in joint warfighting;
- Leverage and integrate ongoing CINC, Service, and DoD agency experiments;
- Conduct joint experiments to explore, demonstrate, and evaluate joint warfighting concepts and related processes and techniques; and
- Provide recommendations in terms of Doctrine, Training, Leadership Development, Organizations, and Materiel to improve joint operations.

SMDC will take proactive steps, acting primarily through the Space and Missile Defense Battle Lab and USARSPACE, to ensure that Army space equities are embedded throughout the joint experimentation system and also to ensure that Army space doctrine, forces, and materiel acquisition programs integrate and leverage advances in the joint arena.

Leader Development

The development of leaders able to exploit space in support of ground operations is a continuing challenge. The need for such officers will grow as space systems and space products become more integrated into the Army operational cycle. The Army, through SMDC, is addressing this need on a number of levels. Plans to enhance the integration of space into training and exercises have been discussed. SMDC is working with the Army Staff and TRADOC to ensure that space instruction is emphasized at the US Army War College and at the Command and General Staff College. PERSCOM and SMDC are also working actively to institutionalize the new Functional Area 40 (Space Operations) and to enhance the capabilities of officers awarded the 3Y (Space Activities) ASI.

Army War College (AWC)

AWC presently integrates space topics into its major subject areas and makes space a critical element in evaluated exercises. Several classes in the core curriculum integrate space. These include classes that address:

- **Weapons of Mass Destruction (WMD).** This class considers both military and non-military space-based systems that can be employed in situations where an adversary has the potential to employ WMD.

- **Joint Land Warfare**. This class explores future joint operations. Space systems are incorporated into discussions concerning Joint Vision 2010. Space concepts are also included in discussions on characteristics of the future Army such as strategic mobility, joint and multinational connectivity, and battlespace awareness.

- **Space Support to the CINC**. This class studies the use of space in support of joint and combined operations. Its learning objectives include understanding the respective roles of the joint command, USSPACECOM, and the services in space operations and understanding USSPACECOM support to the theater commander.

- **Information Operations**. This class addresses space as an enabler of information warfare, command and control warfare, and information assurance.

In addition to classroom instruction, AWC requires that students demonstrate an understanding of the application of space systems in an evaluated Campaign Planning Exercise (which culminates in the preparation of a campaign plan). The students must also demonstrate these capabilities in a major two-week end-of-course Strategic Crisis Exercise that draws on the concepts and skills taught throughout the course.

Command and General Staff College (CGSC)

Present

The core curriculum at CGSC presently includes three hours of instruction regarding space (one hour on space forces, and two hours on space capabilities). CGSC has also offered two space-oriented elective courses, entitled

"Space Orientation," and "Space Operations." Completion of the space operations elective results in award of the 3Y (Space Activities) ASI. Approximately 30 students are awarded this ASI each year. In the future, this course will be expanded and it will constitute one of several transitional courses for FA 40.

Future

Space applications at CGSC, as at AWC, will be integrated into exercises and wargames. In addition, SMDC training developers (in conjunction with the course authors under the offices of the tactics director and the director of academic operations) are currently adding space learning objectives to tactics courses and to the core curriculum. These learning objectives will be applicable for students graduating in 2000-01.

Functional Area 40 (Space Operations)

Dedicated space operations officers are increasingly needed to exploit the capabilities of space systems. These officers will bring capabilities and knowledge of tasking, processing, exploitation and dissemination of space-based products, information and warnings. In addition, and more importantly, these officers will provide unique operational expertise to the planning and operational employment of space operations to enhance land operations. The Army's newest functional area, the recently approved FA 40 (Space Operations), addresses this need and will provide such support to commanders into the 21st Century. FA 40 officers will have the expertise necessary to fully exploit the space component of information operations and will be proficient in all aspects of space operations, which include the four mission areas of space control, force enhancement, force application, and space support. Such expertise will include: communications; command and control; positioning, navigation, and timing; weather, terrain and environmental monitoring; satellite-based intelligence collection; and joint space operations.

FA 40 officers will be eligible to serve in a number of challenging space oriented positions once they have completed the educational process. The educational process will instill knowledge on all space functional areas and prepare the FA 40 officer to assume positions in a variety of space operations. Assignment opportunities for FA 40 officers are depicted in Figure 4-1. While specific educational requirements are still being developed, candidate education programs for FA 40 include:

- The Interservice Space Fundamentals Course and the Senior Interservice Fundamentals Course provide grounding in space operations for personnel with little or no experience in space. Content includes classes in space environment; orbital mechanics; doctrine and law; space organizations and systems; command, control, and surveillance; theater missile warning and national missile defense.

- The Space Applications Advanced Course, targeted for ranks through colonel, provides the in-depth training necessary for exploiting DoD, civil, commercial, and national space systems. Course content includes space system capabilities, applications, and support/coordination considerations.

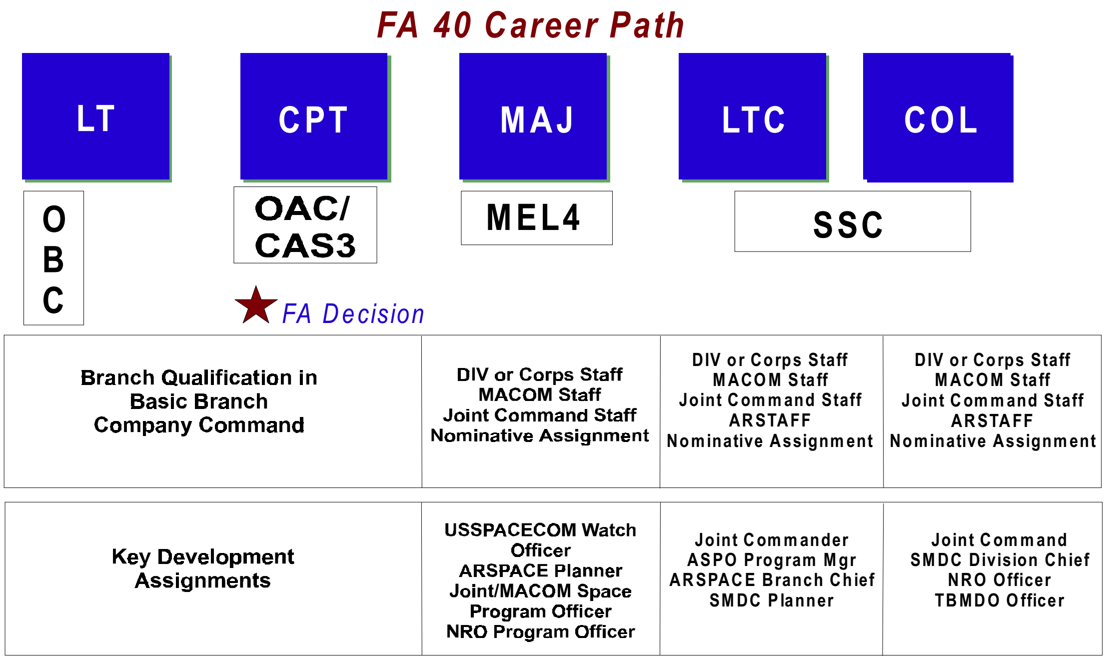


Figure 4-1: FA 40 Career path

- The Space Applications Senior Officer Course, targeted for colonels and above, provides an understanding of how space capabilities apply to operational situations and emphasizes the integration of space capabilities and systems into planning, battle management, and execution.

- The AOC Space Applications Course emphasizes how space system capabilities, limitations, and applications support air operations.

3Y Space Activities Identifier

The 3Y (Space Activities) Additional Skill Identifier currently provides officers with space expertise who can formulate space policy, develop space-related operational concepts, and operate space-based systems. Additionally, they will be able to conduct research in and development of technologies applied to the space environment. The ASI is awarded to officers who successfully complete twelve months in a documented 3Y position, attend the Interservice Space Fundamentals Course and successfully complete six months in a documented 3Y position, or complete the Army Space Operations elective at CGSC. Additionally, ASI 3Y may be awarded based on civilian education.

On award of the 3Y ASI, officers are eligible for assignment in a number of positions requiring expertise in the use of space systems and products. Due to limitations in the Army force structure concerning the number of authorized FA 40 officers and FA 40 positions, the ASI 3Y program will enable the Army to train space-literate officers in other career fields and to maintain a broad base of space experience in staff positions.

Organizations

The growing importance of space to the Army is already being reflected in major organizational changes aimed at improving the use of space systems. The establishment of SMDC as the proponent for space constituted a major step forward in the integration of space. A current initiative to establish an organization in the corps headquarters will have a beneficial effect in operationalizing space at the operational and tactical levels. This organizational structure and other initiatives will be examined in future wargames and exercises. The goal is to keep pace with Army transformation processes. The optimum end state may be to have special staff sections that are organic to land component commanders, corps commanders, and (potentially) division commanders. This section would be led by an FA 40 Officer and task organized by mission and concept of operations.

SMDC

In February 1997, the Commanding General (CG), Space and Strategic Defense Command (SSDC) (now SMDC) was assigned proponency for space and missile defense in the Army. Since that time, SMDC has become the focal point for Army space interests in DTLOMS solutions, requirements integration, and science and technology development. Other Army organizations work in conjunction with SMDC to fully integrate space capabilities and assets into Army systems and missions. A discussion of Army space requirements coordination and integration procedures was provided in Chapter 3. SMDC's organizational structure has expanded to include the:

- **US Army Space Command (USARSPACE).** USARSPACE is the Army component of USCINCSPACE and conducts space operations in support of the Land Component Commanders of combatant commands and Joint Task Forces. It commands the 1st Satellite Control Battalion. JTAGS and Regional Space Support Centers worldwide. USARSPACE's Army Space Support Cell and Army Space Support Teams provide an interface between USSPACECOM and ground warfighters. It represents the Army in the USSPACECOM Space Planning and Requirements System (SPRS), and it manages Army astronauts. ARSPACE also plans to implement multi-service manned Joint SATCOM Support Centers.

  Army astronauts are selected by NASA in a biennial process and detailed by the Army to NASA. An astronaut's tour of duty is currently six years. There are currently seven NASA-approved Army astronauts. There are an additional five Army astronaut candidates who have been assigned to the US Army Astronaut Detachment pending acceptance into the Astronaut Program. Astronaut candidates are currently accessed into the Army Acquisition Corps (FA 51). Accepted astronauts are programmed to become FA 40 to ensure that astronauts are retained as highly visible representatives of the Army's space program.

- **Space and Missile Defense Acquisition Center.** This organization centralizes materiel development functions and testing and evaluation activity. It consists of the Army Space Program Office, US Army Kwajalein Atoll and Kwajalein Missile Range and the High Energy Laser Systems Test Facility.

- **Space and Missile Defense Battle Lab (SMDBL).** The SMDBL plans and conducts live, virtual, and constructive space and missile defense warfighting experiments, studies, and analyses, and supports various exercises and training events with space functions. Additionally, the SMDBL obtains or develops the space related modeling and simulation tools to support the above.

- **Space and Missile Defense Technical Center (SMDTC).** The SMDTC emphasizes space technology development and pursues opportunities for international cooperation and partnership with academia, industry, and other government organizations.

- **Force Development and Integration Center (FDIC).** The FDIC is responsible for space proponency matters. It develops, coordinates, and prioritizes Army actions associated with combat and materiel development. It integrates and synchronizes DTLOMS solutions and performs requirements determination functions to ensure that solutions are both horizontally and vertically integrated.

Corps Redesign

A major effort is underway in the Army to establish a space operations organizational entity within the structure of the Force XXI corps headquarters. This organization will:

- Plan and integrate space operations into corps operations.

- Assist in planning and coordinating the effects derived from space systems, artillery, close air support, army aviation, naval gunfire, and offensive information operations.

- Assist in integrating land, air, sea, and space fires assets to support the corps to employ firepower.

Division-Level Manpower Requirements Criteria Study

Understanding that the operationalization of space would be greatly enhanced at the tactical level by placing a space-oriented organizational structure below the corps-level, SMDC has initiated an effort to determine the manpower requirements criteria to develop a space operations cell within the division headquarters. This study is scheduled for completion in FY01.

Space Partnerships

The Army has a strong interest in establishing responsive, mutually supportive partnerships with government and civilian organizations that have equities in space. Such partnerships allow the Army to leverage a wide pool of expertise and to share experimentation and development costs. SMDC Vision 2010 states "of particular interest will be international alliances, mixed commercial and government space use, military capabilities on board commercial satellites, ground station requirements, policies and treaties, partnerships with national agencies, and affordable responsive launch capabilities." At present, both the Eagle Vision II and Discoverer II programs benefit from partnership programs. Additionally, TRADOC, SMDC, and the NRO co-sponsored the Army After Next Space Franchise wargames.

Soldiers

Soldiers and non-commissioned officers increasingly require a basic understanding of the effects of space systems on the performance of their missions. At present, there is no MOS dedicated to space. Soldiers who work with space systems or who are assigned to space-related positions do so in the context of their individual MOSs. This will continue in the future. For example, Signal soldiers and Military Intelligence soldiers, operating within their MOSs, will work increasingly within the context of space and with space products. Air Defense Artillery and Field Artillery soldiers will become increasingly reliant on space-based systems. These soldiers in particular (and all soldiers in general) will need to become increasingly familiar with space systems, space products, and the connectivity to space. Space-related training should be integrated into Advanced Individual Training to ensure that soldiers are provided the space-related skills necessary to work within their respective MOSs.

FOC Traceability

Traceability of the DTLOS initiatives to approved space FOCs is shown in Table 4-2.

DTLOS Domains	Initiative	1998 FOCs Supported
Doctrine	TP 525-5	All
	TP 525-60	All
	TP 525-66	All
	FM 44-50	001, 002, 009, 015, 016, 020
	FM 100-5	All
	FM 100-6	All
	FM 100-12	001, 002, 009, 015, 016, 020
	FM 100-18	All
	JP 3-13	All
	JP 3-14	All
Training	Space Education	018
	Field Exercises	018
	AWE	007, 018
Leader Development	AWC	018
	CGSC	018
	FA 40	007, 018
	3Y ASI	018
Organization	SMDC Reorg	All
	Corps Redesign	All
	Div MARC	All
	Space Partnership	All
Soldiers	MOS Enhancement	018

Table 4-2: Summary of Non-Materiel Activities

Summary

The sum total of the non-materiel space initiatives described in this chapter indicates that the Army is becoming more keenly focused on operationalizing and institutionalizing space. Current activities, often the result of individual or teamed efforts between single commands, are being superseded by a broad scope of fully integrated *Army-level* initiatives that will provide:

- A body of mature space doctrine which will enable the Army to better exploit space systems, determine its space requirements, better adapt to advances in national and joint space policy, and that will serve as the basis for the inclusion of space doctrine in *all* Army publications.

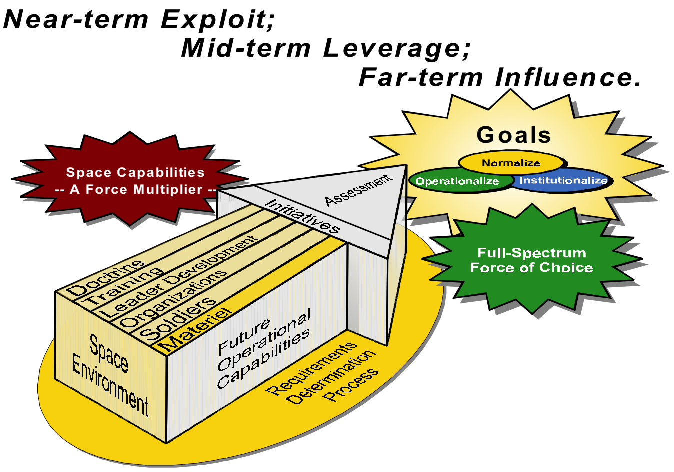
- A thoroughly developed program of space education and training initiatives ranging from standardized education in TRADOC schools to the integration of space related activities in major field exercises and Advanced Warfighting Experiments.

- Enhanced preparation of leaders able to exploit space in support of the warfighter. This will be accomplished through enhancements in the AWC and CGSC curriculum, through the institutionalization of FA 40, and through the further strengthening of the 3Y ASI program.

- The establishment of new organizations and partnerships aimed at integrating and facilitating space operations throughout the Army.

- Initiatives to enhance space literacy and space competency requirements in MOSs concerned with the use of space systems and space products.

Chapter 5: Current Systems and Modernization Strategy



Introduction

This chapter presents an overview of the currently programmed space systems that will have the most impact on the Army through the year 2005. Additionally, there is an extrapolation out to the year 2025. The modernization strategies focus on improving past capabilities while preparing for the first digital division in 2000 and the first digital corps in 2004. In order to meet these challenges, modernization from 2011 to 2025 will make it possible to maintain information superiority and gain enhanced full spectrum operations. The Army's requirements for space capabilities will significantly increase during the next two decades. The promise of digitization and information superiority is highly dependent upon assured access to adequate space and related ground assets and seamless integration with complementary capabilities.

Currently Programmed Systems

Army materiel programs using space assets have evolved to keep pace with NRO, NASA, Air Force, and commercial capabilities and continue to evolve to prepare for the next generation of satellites. Use of space "products" has grown significantly since Operation Desert Storm, and anticipated Army use is expected to increase dramatically in the future.

This section describes currently programmed systems, organized into the following areas:

- Communications
- Reconnaissance, Intelligence, Surveillance, and Target Acquisition
- Weather, Terrain and Environmental Monitoring
- Position, Navigation, and Timing
- Missile Warning
- Space Control
- Space Support

Annex D contains detailed descriptions and timelines associated with each space or ground station item listed in the following summary tables.

Communications

Satellite communications have been vital to senior commanders and high priority missions for years. The Army uses all means available to provide voice, data and imagery transmission, including UHF, SHF and EHF satellites. Project Manager (PM) MILSATCOM is responsible for the acquisition, materiel development, product improvement, testing, fielding, and integrated logistics support of tactical MILSATCOM ground terminals and EHF network control. PM MILSATCOM is the Army's acquisition manager for all fixed or portable Army ground terminals except strategic and control terminals for DSCS. Project Manager, Defense Communications and Army Transmission Systems (PM-DCATS) is responsible for project/product management for DSCS installations, strategic terminals, control systems, and facilities sub-systems. CECOM Space and Terrestrial Communications Directorate (S&TCD) provides system engineering and terminal design engineering for all UHF, SHF, EHF, and Commercial SATCOM systems and manages many STOs, ATDs, and Experiments (described in Chapter 6) that serve as feeders to SATCOM systems.

Category	Space Segment	Ground/Control Segment	Echelon
Ultra High Frequency (UHF) (Mobile)	UHF Follow-On (UFO)	AN/PSC-3 & VSC-7 (phasing out) Being Replaced by AN/PSC-5 (SPITFIRE)	BN and Above
Super High Frequency (SHF) (WIdeband)	Defense Satellite Communications System-III (DSCS-III) Gapfiller Advanced Wideband	AN/TSC-156 STAR-T/ SOFTACs DISA-STEP RSCCE/ODOC AN/GSC- 49 JRSC Universal Modem Army Terminal Upgrade (AN/FSC-78/79 & AN/GSC-3952) TROJAN SPIRIT II	BN and Above ARSPACE FIXED SITES EAC and Below
Extremely High Frequency (EHF) (Protected)	Milstar-I/II Advanced EHF	AN/PSC-11 SCAMP BLOCK I/II, single channel AN/TSC-154 SMART-T, multi-channel Command Post Terminal (CPT)	BN and Above BDE and Above CINC
Advanced MILSATCOM	Global Broadcast Service (GBS) Other	Primary Injection Point (PIP) Theater Injection Point (TIP) Ground Receive Terminal (GRT) Commercial Terminal	
National S-Band		Chariots S-Band Transceivers	
Commercial	Iridium INTELSAT PANAMSAT GSTAR DOMSAT INMARSAT	Mobile Satellite Services (MSS) Military Individual Communicator (MIC) TROJAN SPIRIT	TBD EAC and Below

Table 5-1: Communication Satellite Systems Used by Army

The Army has fielded SATCOM systems to selected units, and continues to program resources to purchase upgraded equipment. Table 5-1 lists the current or near term systems the Army is deploying (ground segment or terminal) displayed next to its supported space segment. The emphasis in the near term is the consolidation of previous ground stations into a new generation of smaller, lighter, more transportable and more capable set of transmitters and receivers. An example is Block I SCAMP, which is currently 37 pounds, is being downsized to a Block II SCAMP which will be 12-15 pounds and have additional capabilities. Additional communication details are contained in Annex D.

Reconnaissance, Intelligence, Surveillance, and Target Acquisition (RISTA)

Appropriate, reliable and timely RISTA is the cornerstone of all Army planning, from pre-ingress to recovery. Satellite systems have been providing support to this process for over 30 years and Army ground systems have evolved to take advantage of all available information sources. Table 5-2 portrays the TENCAP systems the Army relies on to access national ISR data. Often, these data are transmitted through both secure and open SATCOM links. The TENCAP program is the conduit for this information to the Land Component Commander as well as Corps and Division Commanders. The table presents TENCAP ground systems now in operation and the core of the near term modernization strategy. Details of every system function are provided in Annex D. The asterisk beside the Tactical Exploitation System (TES) programs reflects the near-term modernization strategy. TES replaces multiple systems and will reduce errors, costs and deployment time into the theater. In the longer term, the TENCAP TES will evolve

Space Segment	Ground/Control Segment	Echelon
National Systems Commercial Systems	Modernized Imagery Exploitation System (MIES)	CORPS and EAC
	Enhanced Tactical Radar Correlator (ETRAC)	TASK FORCE, DIV, and CORPS
	Advanced Electronic Processing and Dissemination System (AEPDS)	CORPS AND EAC
	Mobile Integrated Tactical Terminal (MITT)	BDE, DIV, CORPS
	Forward Area Support Terminal (FAST)	ACR, DIV
	Tri-band SATCOM Subsystem (TSS) Chariot	COMM TERMINAL COMM TERMINAL
	Synthesized UHF Computer Controlled Equipment Subsystem (SUCCESS)	COMM TERMINAL
	Tactical Exploitation System (TES) TES-Fwd	CORPS CORPS
	Division TES (DTES)	DIV
	TES-Light	CORPS

Table 5-2: Reconnaissance, Intelligence, Surveillance, and Target Acquisition (RISTA) Systems

into an even more capable, more compact ground interface with sources of information. Note additional RISTA details in Annex D.

Weather, Terrain and Environmental Monitoring Systems (WTEM)

The Army currently receives weather information from the Defense Meteorological Satellite Program (DMSP) through Mark IVB and Small Tactical Terminals operated by the Air Force. The joint DoD/DoC National Polar Orbiting Environmental Satellite System (NPOESS) will replace DMSP. NPOESS services will not be available until the 2009 time period. In the meantime, the Integrated Meteorology System (IMETS), owned by the Army and operated by the Air Force, will provide in-theater weather services. IMETS will interface with the DMSP and other weather satellites as available until NPOESS comes on line. Environmental monitoring is somewhat limited until NPOESS data are available.

The interface with terrain data is provided by the Digital Topographical Support System (DTSS), which is described in Annex D. The system maintains and accesses historical databases for the field planners; these databases contain data collected by national systems and unclassified remote sensing satellites (such as LANDSAT) as well as data developed from conventional means (aircraft, survey, etc.). Note additional WTEM details in Annex D.

Space Segment	Ground/Control Segment	Echelon
WEATHER Defense Meteorological System Program (DMSP)	Mark IV-B Small Tactical Terminal (STT)	CORPS and Above BDE and Above
National Polar Orbiting Environmental Satellite System (NPOESS)	Integrated Meteorological System (IMETS)	CORPS and Above
TERRAIN National Assets Remote Sensing Satellites	Digital Topographical Support System (DTSS)	BDE and Above

Table 5-3: Weather, Terrain, and Environmental Monitoring (WTEM) Systems

Position, Navigation, and Timing

The advent of the NAVSTAR Global Positioning System, commonly called “GPS”, has had a far-reaching effect on near term Army systems and planning. Table 5-4 provides a partial listing of the ground receiver units currently or soon to be in the inventory. This is a reflection of how important time, location, and situational awareness are to today’s Army and, more importantly, the Army of the future. The Army shares the concerns of the other services regarding the potential for jamming and interruption of GPS capability in an environment where great dependence is placed on satellite-based position and navigation support. This is discussed further in the Position and Navigation Section in the Post-2005 Modernization Strategy. Note additional POSNAV details in Annex D.

Space Segment	Ground/Control Segment	Echelon
NAVSTAR Global Positioning System (GPS)	Precision Lightweight GPS Receiver (PLGR) GPS 3A Receiver Miniaturized Airborne GPS Receiver (MAGR) Miniaturized Airborne GPS Receiver 2000 (MAGR-2000) GPS Receiver Applications Module (GRAM) Cargo Utility GPS Receiver (CUGR) Special Operations Lightweight GPS Receiver (SOLGR) Standalone Air GPS Receiver (SAGR) AN/ASN-169	N/A (Used at All Echelons)

Table 5-4: Navigation Satellite Systems

Missile Warning

The Joint Tactical Ground Station (JTAGS), developed by the Army and now deployed, has become the standard for providing warning of missile attack against units in theater, regardless of service. JTAGS analyzes a direct downlink (DDL) from the Defense Support Program (DSP) early warning satellites to determine if a threat ballistic missile has been launched and, if so, where it originated, where it is going and when it will arrive. This information is transmitted throughout the theater. As the DSP satellites are replaced with the state of the art Space Based Infrared System (SBIRS), the JTAGS capabilities will be transitioned to the Multi-Mission Mobile Processor (M3P), a completely Joint missile warning system. Note additional Missile Warning details in Annex D.

Space Segment	Ground/Control Segment	Echelon
Defense Support Program (DSP)	Joint Tactical Ground Station (JTAGS)	EAC
Space Based Infrared System-High (SBIRS-High)	Multi-Mission Mobile Processor (M3P)	ECB

Table 5-5: Missile Warning Systems

Space Control

Space control strategies depend on very precise and timely information on objects' locations in space and detailed knowledge of the objects' orbital parameters. This information is essential to placing a satellite in an orbit with minimum risk of collision, determining when an adversary's asset may be overhead or determining a fire solution for an anti-satellite system (laser, electromagnetic pulse, kinetic energy, etc.). The radars at the Kwajalein Missile Range (KMR) listed in Table 5-6 support this mission with the most accurate data available on the smaller objects in orbit. This capability is of substantial importance when selecting launch and orbital parameters for spacecraft in order to minimize the probability of dangerous encounters with small debris. Note additional Space Control details in Annex D.

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Space Segment	Ground/Control Segment
Objects in Orbit	ARPA Lincoln C-Band Observable Radar (ALCOR)
	ARPA Long-Range Tracking and Identification Radar (ALTAIR)
	Millimeter Wave (MMW)
	Tracking and Discrimination Experiment (TRADEX)

Table 5-6: Space Object Tracking Systems Operated by Army

Space Support

The space support mission area focuses on the deployment, operation, sustainment, augmentation and recovery of space assets. This mission has two primary focal points: Launch Operations (executing military spacelift and range operations) and Satellite Operations (controlling and maintaining on-orbit military satellites). This high cost mission is the number one priority of Air Force Space Command. Primary Army support to the United States Space Command (USSPACECOM) for materiel systems is operation of the DSCS Operations Center (DSCSOC), which provides network control, payload control, and backup, in-band, platform control in certain limited cases. Another near-term modernization is focused on bringing the upgraded Objective DSCS Operations Center (ODOC) on line. Note additional Space Support details in Annex D.

Space Segment	Ground/Control Segment
Defense Satellite Communications System (DSCS)	DSCS Operations Center (DSCSOC)
	Objective DSCS Operations Center (ODOC)

Table 5-7: Space Support Systems Operated by Army

Post-2005 Modernization Strategy

The near-term modernization strategy focuses on equipping the force (i.e., increasing ground segment availability), broadening the understanding within the Army of what space assets can provide, and working with the DoD space agencies (USSPACECOM, DoD level space agencies, US Air Force, and NRO) to insure that Army requirements are incorporated into future systems. Annual budget pressures, political restructuring and domestic and international events will affect some details of near term plans and schedules, but we expect no major changes in the operational capabilities discussed above.

The modernization strategy presented here for 2006 to 2025 is compatible with the needs and constraints expressed through FOCs identified by warfighter proponents and documented in TRADOC Pamphlet 525-66, the Army Modernization Plan, The Army Plan (TAP), the USSPACECOM Long Range Plan, and examination of patterns of war reflected in JV 2010. It also reflects goals previously associated with AV 2010 and the Army After Next projects. These plans provide the basis for identifying "enablers"—those functions required to ensure overmatch capability. The enablers used as the basis for developing this plan fall into the following seven major categories:

- Communications Support
- Position, Navigation, and Timing
- Weather Information
- Terrain Data
- Environmental Information
- Reconnaissance, Intelligence, Surveillance, and Target Acquisition Support
- Force Protection

Each enabler can be further broken down into more specific statements of desired capability, reflecting the specific support the future warfighter requires to achieve overmatch in all patterns of warfare. Based on the planned capabilities for the near term, Table 5-8 shows the Post-2005 Modernization Strategy.

As the Army's new transformation strategy evolves, Army Space will remain engaged to support the evolution with space-based operations. The ASMP can accommodate the Army's deliberate shift in modernization strategy.

It is appropriate to note that the post-2005 modernization strategy deals with the "M" (Materiel) part of the DTLOMS, but there are DTLOS implications in every enabler. For example, as SATCOM capabilities begin to proliferate to echelons below brigade and, ultimately, below battalion, doctrine, training and leadership issues must be addressed. Concepts of Operations (CONOPS) and Tactics, Techniques and Procedures (TTPs) will be required in order to ensure that communications capacity is not saturated or squandered. This process will be absolutely crucial when communication-on-demand and extremely high data rate (EHDR) become available. There will always be limits, which only DTLOS solutions can handle. Similarly, blue force tracking (BFT) in theater can become an unmanageable burden if too many devices are reporting too often. DTLOS initiatives must be developed to ensure that the appropriate information is provided to the commanders. We need to make certain that "information overload" does not defeat our objective of "information dominance". The same basic comments hold for the other six enablers. The materiel solution is only as good as the DTLOS actions that implement it and ensure that the original objectives are achieved.

Table 5-8 provides an overview of the enablers and their subcategories with the planned capabilities for the near-term (and mid-term) and desired capabilities for mid-term and long-term. Each block presents generic characteristics for enablers in each term, names of supporting space programs and Army ground stations in current plans (Annex D), and the delay (in parenthesis) associated with obtaining desired information. Generally, mid- and far-term entries represent "desires."

Incorporating Advanced Technology

Developing the strategy presented in Table 5-8 required combining near term technology efforts with the evolution of planned capabilities. Shown on Table 5-8 are initiatives such as Warfighter I (advanced optical data) and Discoverer II

Enablers	Supporting Space and Ground Segments		
	Near Term (00-05)	**Mid Term (06-11)**	**Far Term (12-25)**
COMMUNICATIONS - IN THEATER (BLOS) - NON-SECURE - SECURE - LIMITED ANTI-JAM - ANTI-JAM -C2 ON THE MOVE - NON-SECURE - SECURE - ANTI-JAM - LONG HAUL - NON-SECURE - SECURE - LIMITED ANTI-JAM -ANTI-JAM	IRIDIUM UFO/SPITFIRE; DSCS/STAR-T COMMERCIAL/SECURE (IRIDIUM, GBS/GRT/TIP) DSCS/STAR-T (UMS) MILSTAR (I,II)/SMART-T/SCAMP BLK I IRIDIUM UFO/SPITFIRE IRIDIUM UFO/SPITFIRE; DSCS/STAR-T COMMERCIAL/SECURE (IRIDIUM, GBS/GRT/TIP) DSCS/SN/FSC-78/79 AN/GSC 39/52 DSCS/STAR-T (UMS) DSCS/AN/FSC-78/79(UMS) AN/GSC-39/52 MILSTAR (I,II)/SMART-T/SCAMP BLK I	COMMERCIAL UFO/SPITFIRE; DSCS-GAPFILLER/ STAR-T COMMERCIAL/SECURE IRIDIUM DSCS- GAPFILLER/STAR-T ADVANCED EHF/ SMART-T/SCAMP (BLKI, II) COMMERCIAL UFO/SPITFIRE, COMMERCIAL/SECURE IRIDIUM, GBS SCAMP BLOCK II COMMERCIAL UFO/SPITFIRE; DSCS- GAPFILLER/ STAR-T COMMERCIAL/SECURE IRIDIUM DSCS- GAPFILLER/AN/FSC- 78/79 AN/GSC-39/52 DSCS- GAPFILLER/STAR-T DSCS- GAPFILLER/AN/FSC-78/79 (UMS) AN/GSC- 39/52 (UMS) ADVANCED EHF/ SMART-T/SCAMP (BLKI, II)	COMMERCIAL MIST MIST MIST COMMERCIAL COMMERCIAL, GBS SCAMP BLOCK II COMMERCIAL MIST ADVANCED WIDEBAND TERMINALS MIST ADVANCED WIDEBAND TERMINALS MIST
POSITION AND NAVIGATION - PRECISION CODE PROTECTED (PCP) - PCP PLUS ANTI-JAM/ANTI-SPOOF (AJ/AS) - ENHANCED PRECISION WITH AJ/AS	GPS	GPS (AJ/AS)	ENHANCED GPS (AJ/AS)
WEATHER - THEATER DATA BASE - NEAR REAL TIME (NRT) ASSESS/FORECAST	DMSP, TIROS, GOES/IMETS DMSP, GOES/IMETS	DMSP, TIROS, GOES, NPOESS/IMETS DMSP, GOES, NPOESS/IMETS	NPOESS/IMETS ADVANCED METSAT
TERRAIN - HISTORICAL DATA BASE - COMPOSITION - EFFECTS OF WEATHER - HIGH SPATIAL RESOLUTION - NEAR REAL TIME (ON DEMAND)	LANDSAT, SPOT LANDSAT, SPOT COMMERCIAL, NRO SPOT, WARFIGHTER, NRO/DTSS (HRS, DAYS)	LANDSAT, SPOT, WARFIGHTER LANDSAT, SPOT, WARFIGHTER WARFIGHTER, COMMERCIAL, NRO HSI SAT/DTSS-FO (HRS, DAYS)	HSI SAT HSI SAT HSI SAT HSI SAT CONSTELLATION (MIN, HRS)
ENVIRONMENT - HISTORICAL DATA BASE - NEAR REAL TIME - CHEMICAL/BIOLOGICAL/NUCLEAR (CBN)	WEATHER & TERRAIN SYSTEMS WARFIGHTER (WF) (DAYS) N/A	WEATHER &TERRAIN SYSTEMS HSI SAT (HRS, DAYS) HSI SAT (HRS, DAYS)	HSI SAT HSI SAT CONSTELLATION (MIN, HRS) HSI SAT CONSTELLATION (MIN, HRS)
RECONNAISSANCE INTELLIGENCE, SURVEILLANCE, AND TARGET ACQUISITION (RISTA) - HISTORICAL DATA BASE - VISIBLE/INFRARED - HYPERSPECTRAL IMAGERY/INFORMATION (HSI) - RADAR IMAGERY - RADAR MOVING TARGET INDICATOR - NEAR REAL TIME/DIRECT DOWNLINK - VISIBLE/INFRARED - HSI - RADAR IMAGERY - RADAR MTI - SIGINT/MASINT/HUMINT	TES, DTES, TES-LIGHT IS UNIVERSAL ARMY GROUND SEGMENT LANDSAT, SPOT, NRO, COMMERCIAL WARFIGHTER NRO DISCOVERER (SPARSE) DISCOVERER (SPARSE) SPOT, WARFIGHTER, COMMERCIAL WARFIGHTER, COMMERCIAL (DAYS) NRO (HOURS, DAYS) DISCOVERER (HOURS, DAYS) DISCOVERER (HOURS, DAYS) NATIONAL ASSETS (REAL-TIME TO DAYS/MONTHS)	TES- LIGHT, DIVISION/BRIGADE DIRECT SPOT, NRO, WF, COMMERCIAL WARFIGHTER, COMMERCIAL NRO DISCOVERER (DAYS) COMMERCIAL, NRO HSI, SAT (HR, DAYS) DISCOVERER FO (MIN, HRS) DISCOVERER FO (MIN, HRS) NATIONAL ASSETS (REAL-TIME TO DAYS/MONTHS)	DCGS-A, BRIGADE, EAC COMMERCIAL, NRO, HSI SAT HSI SAT COMMERCIAL, NRO, SBIRS-LOW HSI SAT CONST. (MIN, HRS) SARSAT CONST. (SEC, MIN) SARSAT CONST. (SEC, MIN) NATIONAL ASSETS-TDL (REAL-TIME TO DAYS/MONTHS)
FORCE PROTECTION - MISSILE WARNING - JOINT TACTICAL GROUND STATION (JTAGS) - MULTI-MISSION MODULE PROCESSOR (M3P) - NATIONAL MISSILE DEFENSE - SPACE CONTROL - ANTI-RISTA (NEGATE, DENY, DEGRADE) - SPACE ASSET PROTECTION BLUE FORCE TRACKING (BFT) BEYOND LINE OF SIGHT (BLOS)	DSP/JTAGS SBIRS-H/M3P DSP/SBIRS-H SPACE TRACKING & WARNING (NATIONAL) ELINT, SIGINT JAM/SPOOF HARDENING, RECONSTITUTION (H,R) GRENADIER-BRAT (G-B) WRAP	SBIRS- H/M3P SBIRS- H GROUND BASED LASER (GBL), KEASAT IN-THEATER TRACKING & WARNING H, R, REDUNDANCY (H, R, R,) G-B FOLLOW-ON	SBIRS-L/SBIRS-H/M3P SBIRS-H/SBIRS-L GBL, KEASAT, EMP SAT IN-THEATER SPOOF/JAM (ALL TYPE) H, R, R, EVADER, ON-ORBIT DEFENSE HDR BFT

Table 5-8: Modernization Strategy (Materiel)

(radar imaging and moving target indicator) which are described in Chapter 6. These technology programs are extrapolated into mid-term programs, which are the "bridge" to achieving the 2025 capabilities, which provide the "pull". Technology advances supporting space capability developments will occur in Army programs and in non-Army government and commercial laboratories and R&D facilities. The Modernization Strategy also assumes aggressive programs within the Army to develop materiel (hardware and software) and DTLOS that take full advantage of the capabilities available in 2025.

Communications

Beyond line of sight (BLOS) communications in theater, command and control (C2) on the move (line of sight independent), and long haul (i.e. out of theater, CONUS, etc. to support split based operations planning during transit, etc.) are the major areas of interest for using space assets. The potential into the 2025 time period is for use of non-secure UHF and SHF satellite links, possibly leased from commercial sources. The far-term column reflects two near-revolutionary developments (Communication on Demand and High Data Rate (HDR)) which must take place to meet the future desired information and communication capacities.

The Army of 2010 will still have restricted access to satellite communication capacity and limited capability to share information through satellite links. Therefore, the modernization strategy reflects the need to correct this situation between 2011 and 2025. There are certain overarching concepts under study within the C4I arena such as "net-centric warfare" which have many possible implications for DDL and in-theater tasking, as well as for the larger roles and missions issue of spacecraft control. PM MILSATCOM is currently working an architectural issue to provide BLOS capability to interface either a Spitfire or SCAMP terminal into the tactical internet and FBCB2

Position, Navigation (Pos/Nav) and Timing

The availability of standard and precision code NAVSTAR Global Positioning System (GPS) satellite data has created a true revolution in navigation in the military and civilian sectors. The Army uses GPS extensively, as evidenced by the number of receivers described in Annex D. Four areas of concern have been identified by Army users. First, the relatively low signal strength from the satellites results in signal "masking" problems in certain rough terrain and urban environments. Certain dense foliage can create problems in acquiring and staying locked on to satellites. Second, it has been demonstrated that GPS users are susceptible to jamming and, theoretically, spoofing (i.e. generating an incorrect estimate of location and/or time). The third concern is the potential for degrading or negating GPS by neutralizing a portion, or all, of the satellite constellation. Fourth, an adversary may use GPS navigation on-board cruise missiles and UAVs to enhance accuracy during attacks on ground forces. The effectiveness of this ploy would be enhanced if the enemy had precision code capability. The modernization strategy assumes that these issues will be addressed as follows:

In the near-term, it is necessary to control Precision Code capability in order to minimize proliferation of inexpensive weapons capable of accurate, autonomous navigation. The solutions to the problems associated with signal masking, jamming, and spoofing will start to be implemented in the mid-term.

Implied in the TRADOC Pamphlet 525-66 FOCs and explicitly called for in The Army Plan is an increase in precision code accuracy, resulting in location uncertainties of one to three meters, depending on the application. The objective POS/NAV system for 2025 should have anti-jam and anti-spoofing capability, less than or equal to three meter absolute accuracy, and protection against attack by adversaries.

Weather

NPOESS and IMETS will be operational into the far-term, with an advanced meteorological satellite (Advanced METSAT) projected to replace the aging NPOESS technology in the latter years. Emphasis in the modernization strategy will be on higher resolution and faster turnaround, leading to improved spot forecasting supporting effective planning and operations. A Portion of the requirement may be met using commercial systems.

Terrain

Accurate terrain data supports all aspects of Army planning and ground battle execution. Two types of terrain data are required to assure success within the future patterns of warfare: historical and near-real time (NRT). An in-depth historical data base currently being developed by the National Imagery and Mapping Agency will not only contain high resolution three dimensional digital terrain characterization, but also observations obtained before, during and following weather changes and changes of seasons, movements of personnel and materiel. It is desirable to incorporate foliage characteristics, ground trafficability, levels of rivers, and other factors into campaign and maneuver planning, and a historical database, coupled with a good weather forecast, can be invaluable to ensuring the required outcome. The historical database also serves another purpose. It makes interpretation of near real time data more rapid and enhances confidence in the results. However, the existing databases provide only rudimentary capabilities and are not sufficient to meet the needs of the future warfighter. These databases will be expanded through the near and mid term with the advent of Warfighter (optical) and Discoverer II (synthetic aperture radar) developmental satellite platforms described in Chapter 6. In the near-term, generating three dimensional terrain maps for a specific region will continue to require weeks of lead-time, even at relatively low resolution. The far term objective capability reduces this time to hours at high resolution. Advanced optical sensor constellations and radar satellite constellations directly tasked in theater will augment available databases.

Environment

Monitoring (and predicting) the environment in a particular region requires the same type of sensing capabilities used for weather and terrain data base development and assessment. There will be differences in sensor parameters and processing algorithms in some cases but it is anticipated that the same satellites and ground stations will provide the desired coverage. However, environmental monitoring has several unique requirements, particularly as relates to detecting and tracking released chemical, biological and nuclear agents, and analyzing such things as exhaust vapors.

Reconnaissance, Intelligence, Surveillance, and Target Acquisition (RISTA)

As shown on Table 5-2 and discussed in Annex D, the TENCAP Program is consolidating its ground station capabilities in the TES and its derivatives. TES will provide interfaces to several sources of ISR data, including non-satellite systems, and represents the universal ground segment for the Army into the next century. The TES capabilities will require expansion as the advanced optical sensor constellation and radar satellite constellation data sources come on line and databases evolve exponentially.

The vertical and horizontal distribution of information will also expand in the far term to support information dominance and the Army's intention to shape the battlespace. The time required to supply RISTA information to theater commanders will shrink from hours and days to minutes. A mix of DoD and commercial systems will be used to satisfy the full spectrum of requirements.

Force Protection

The guiding documents for this modernization strategy are very specific on three requirements relating to force protection. One is the need to provide warning of attack by ballistic missiles at the earliest possible moment, including expected impact point, impact time and threat characterization. A launch point estimate is also desired to support attack operations against the launcher and if possible the associated support equipment and infrastructure. The second requirement (space control) is for protection from adversarial space-based RISTA. The third requirement is to ensure protection for those assets in space that are so crucial to our dominance of the future patterns of warfare.

The first of these requirements is being met in the near and mid term by JTAGS and the transition to M3P as described above and in Annex D. Time from launch detection to alert is shortened, accuracy in determining launch location is increased, and the accuracy in determining impact point is increased in the far term by adding an interface to the SBIRS-Low.

The space control portion of force protection is more complex. A variety of international and treaty issues are involved. The capabilities called out on Table 5-8 reflect what is technically possible in near, mid and far term. The possibilities range from jamming and spoofing sensors to complete destruction of a satellite using lasers or kinetic energy weapons. The far-term would give the theater commander the capability to spoof or jam satellites which might have a look (optical or radar) at any crucial phase of an operation or deployment.

Protection for our assets in space range from radiation hardening of some systems and the ability to launch replacements. In the far-term, the capability to evade and to provide on-orbit defenses could be developed. On-orbit defenses include self-defense and defense by a neighboring satellite.

Beyond Line of Sight (BLOS) Blue Force Tracking has previously been considered a subset of command, control and communications. However, the desire to have near perfect knowledge of the location and vector of all friendly forces is prevalent in all desired capabilities, especially for limited line of sight and deep strike situations. The overarching significance of this capability for all aspects of executing the land battle lead to its designation as a unique enabler.

The modernization strategy assumes that line of sight systems will be developed and used to satisfy DoD Global Command and Control System Common Operational Picture (GCCS COP) requirements for near real time BFT. BFT-BLOS will be the domain of satellite or airborne (such as UAV) receivers. Grenadier-BRAT (G-B) is a current ASPO developed Army system concept to provide BLOS capability on an interim basis. G-B is a small device that uses GPS timing and position signals and automatically reports that information, plus a situation code, on an interval programmable by the user. G-B uses a low probability of intercept/low probability of detection (LPI/LPD) broadcast waveform compatible with SOF and LRSU operations, as well as with assault helicopters and units moving rapidly in rugged terrain. The current WRAP calls for 450 units (plus spares, displays, etc.) to be procured over FY99-FY00. Exercises and analyses have shown that even a few hundred units operating in theater will require a specific discipline on reporting interval to avoid saturating communications capabilities. Development of CONOPS and TTPs can reinforce communications discipline. A G-B type follow-on, with two way communications, is assumed to be introduced by or during the mid-term. This development is followed by the objective in the far term of providing units down to the equivalent of squad level (in some cases, down to individual manpacks) with an automatic tracking device with two way communication and high data rates (HDR) capable of transmitting real time imagery, data, and voice via satellite in addition to location and vector information. Very robust space support systems will be required for theater level actions where the number of active units may reach 1,000 or more.

Commercial Initiatives

The modernization strategy reflects the use in the near-term of commercial capabilities in communications and remote sensing, and assumes a similar or expanded role in post-2005. Some generic capabilities such as “Advanced METSAT” as a follow-on to NPOESS makes no assumptions as to whether the space system is DoD, other government or commercial. Satellite communications and imaging from space (supporting ISR) using commercial capabilities are explicitly noted in the mid- and far-term as options to enhance government provided capabilities.

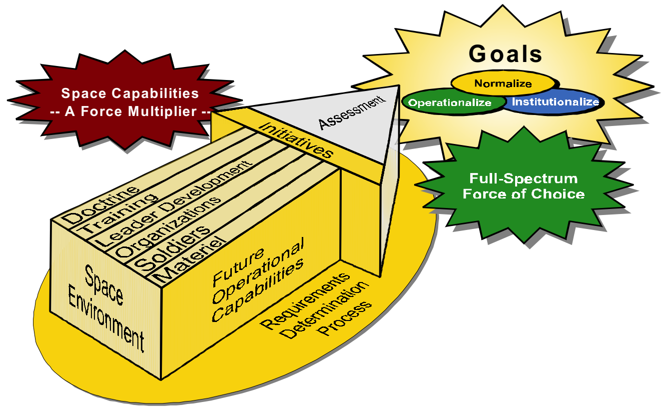
Use of commercial communications by DoD users in the 2000-2010 time period is discussed in the SATCOM section of Annex D. This trend is expected to continue into the far-term; the near-term initiative to make commercial imagery available to theater commanders is Eagle Vision II which is described in Chapter 6. The modernization strategy assumes that access to commercial remote sensing products (supporting database development, planning, and real time execution) will continue.

Summary

The near term DoD and Army space program elements support the goals of JV2010 and the Army Vision. The desired capabilities documented in TRADOC Pamphlet 525-66, the Modernization Plan, and The Army Plan realistically reflect from the warfighter's viewpoint what must be achieved to dominate the battlefield of the future. This Army Space Master Plan modernization strategy provides for an information overmatch capability against any adversary by 2025. At the same time it will give the Army commander the edge in any type of contingency—whether keeping the peace, or dominating in conflict—thus achieving "Dominance Across the Full Spectrum of Operations."

Chapter 6: Army Space Initiatives

Army Space initiatives focus on solving Warfighting Requirements.



Introduction

The principal focus of this chapter is to define space initiatives (technology developments, experiments, and demonstrations) that are designed to satisfy the Army's seventeen space Future Operational Capabilities (FOCs) as contained in TRADOC PAM 525-66. These initiatives also support the Army's concept of operations as articulated in TRADOC PAM 525-5 and TRADOC PAM 525-60. In addition, the initiatives supported the Army Experimentation Campaign Program, and its successes include C4I, Situational Awareness, Expanded Battlespace, Noncontiguous Operations, Army After Next Capabilities, and Just-in-time Logistics.

Space support to Army operations consists of Force Enhancement initiatives: Military Satellite Communications (MILSATCOM); Intelligence, Surveillance, and Reconnaissance (ISR); Weather, Terrain, and Environmental Monitoring (WTEM); Position and Navigation (POSNAV); and Missile Warning. The need to receive timely, accurate and secure information by Army warfighters at the strategic, operational, and tactical levels of war (including operations other than war) places great demands on space assets. To satisfy these increased information requirements, the Army must influence future space architectures and system designs. Vital to battlefield success is the timely merging, processing, and receipt at the appropriate echelon of information derived from space systems.

Initiatives in the area of space control primarily focus on space surveillance and negation. The functional area of Force Application space system protection is currently being studied at the concept level. Future revisions of this plan should capitalize on initiatives in this area to benefit the warfighter.

The use of information derived from military, civil, and commercial space systems is essential to future Army operations. The Army Space Initiatives exploit current military, civil and commercial space architectures by defining performance requirements and developing technologies to satisfy Army specific operational requirements. Annex E is a summary of Army Space Initiatives and the FOCs they support.

Science and Technology Initiatives

This section describes innovative space S&T initiatives that support the full range of attributes associated with the transformed Army. It primarily addresses ongoing space-related research within the Army to improve the Army's use of space. It also addresses some NRO, Air Force, and commercial industry research. The Army Science and Technology Master Plan provides additional details concerning current space-related technology initiatives. Annex E provides details of the space initiatives and relates each with its corresponding organization, timeframe, and Future Operational Capabilities supported.

Science and Technology Objectives

Science and Technology Objectives (STOs) are designed to achieve major technology advancements by specific fiscal year. STOs adhere to predetermined objectives and leverage feedback received from the customer. The following STOs are listed in Annex E, and they are described in the FY99 Army Science and Technology Master Plan. These STOs focus on Space Force Enhancement and Space Control initiatives and support several Army modernization objectives:

- Battlefield Ordnance Awareness
- Overhead Passive Sensor Technology for Battlefield Awareness
- Space Surveillance
- Laser Communications
- Antennas for Communications Across the Spectrum
- Range Extension
- On-the-Move Tactical SATCOM Technology
- Battlefield Tactical Navigation
- Point Hit ATACMS/MLRS
- Profiler Data Fusion
- Precision Guided Mortar Munitions
- High/Altitude, High Offset, Precision Airborne Insertion into Restricted Terrain

For a complete listing including narratives of all Space Application Technology Program STOs noted above, refer to the Army Science and Technology Master Plan.

The following technology programs represent current space related STOs.

Battlefield Ordnance Awareness

Battlefield Ordnance Awareness (BOA) is an SMDC technology program that uses overhead infrared sensors to support counterfire missions and battlefield visualization (Figure 6-1). BOA potentially addresses the Army warfighter's need for near-real-time reporting of ordnance events. The ordnance event is observed by a space sensor, and is downlinked to the warfighter in near real-time, enabling

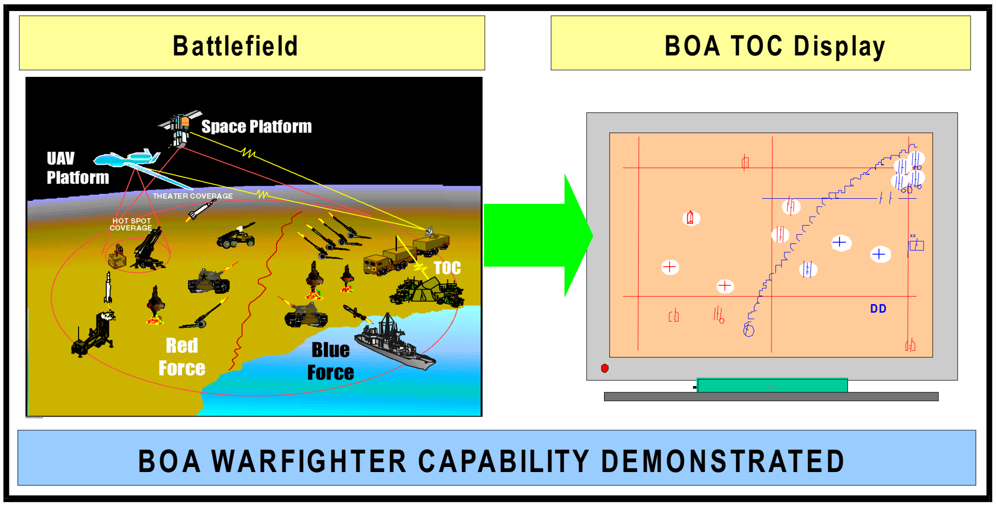


Figure 6-1: Battlefield Ordnance Awareness

friendly targeting of enemy artillery and missile launch sites. BOA classifies ordnance events by type, allowing commanders and intelligence analysts to determine munitions type, firing location, and type of firing unit. Such information will greatly increase situational awareness, targeting, and battle damage assessment. Such an increase in information must be handled in an intelligent and efficient manner. BOA will conclude in FY01.

Overhead Passive Sensor Technology for Battlefield Awareness

The Overhead Passive Sensor Technology for Battlefield Awareness STO is an SMDC technology program that utilizes hyperspectral imagery processing to provide detection and discrimination of battlefield targets (Figure 6-2). Battlefield awareness is enhanced through use of multiple advanced passive sensor

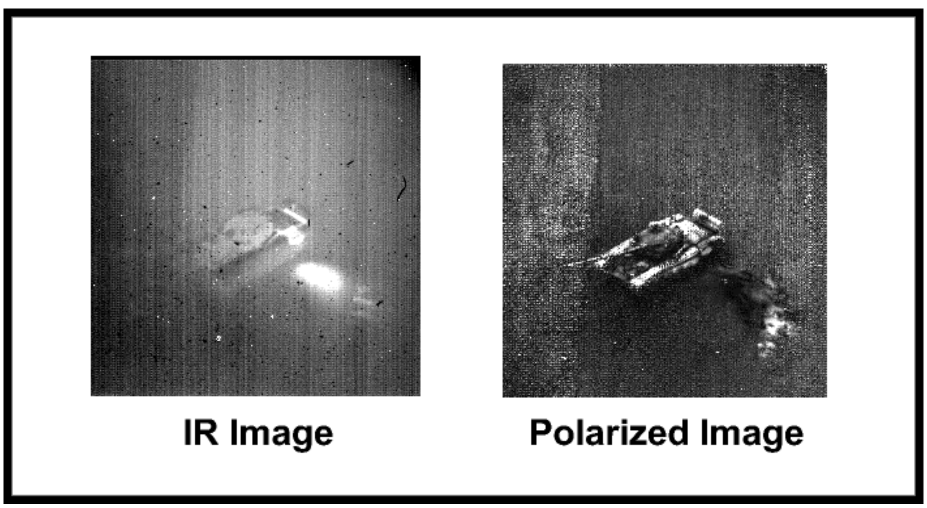


Figure 6-2: Overhead Passive Sensor Technology for Battlefield Characterization

technologies. Hyperspectral imagery processing enables detection, location, and identification of camouflaged and concealed targets in near real-time. On-board sensor data processing occurs prior to information dissemination to the user. This STO concludes in FY03.

Space Surveillance

The Space Surveillance STO is an approved SMDC technology program. Current capabilities to image satellites, observe their orientation (attitude), and analyze their missions and status are tactically limited. The space surveillance STO addresses this mission need. The space surveillance STO detects and assesses hostile or neutral theater-based intelligence, surveillance, and reconnaissance operations in-theater. The concept is to use in-theater, wide-band radars and automated software to determine the attitude of a satellite and the ground swath it is imaging in near real time. Results will be displayed graphically. The concept contributes to land force battlespace awareness and the U.S. Space Command Operated Space Surveillance Network. This STO begins in FY00 and concludes in FY04.

Laser Communications (Lasercom)

Lasercom is an SMDC supported technology program that potentially satisfies future operational capability requirements through use of high bandwidth secure communications (Figure 6-3). Lasercom supports communications with low probability of intercept, mobility requirements (lightweight/compact), and complements existing high data rate transmission requirements. SMDC is conducting air-to-ground and satellite-to-ground demonstrations in conjunction with the Ballistic Missile Defense Organization (BMDO). This STO concludes in FY99.

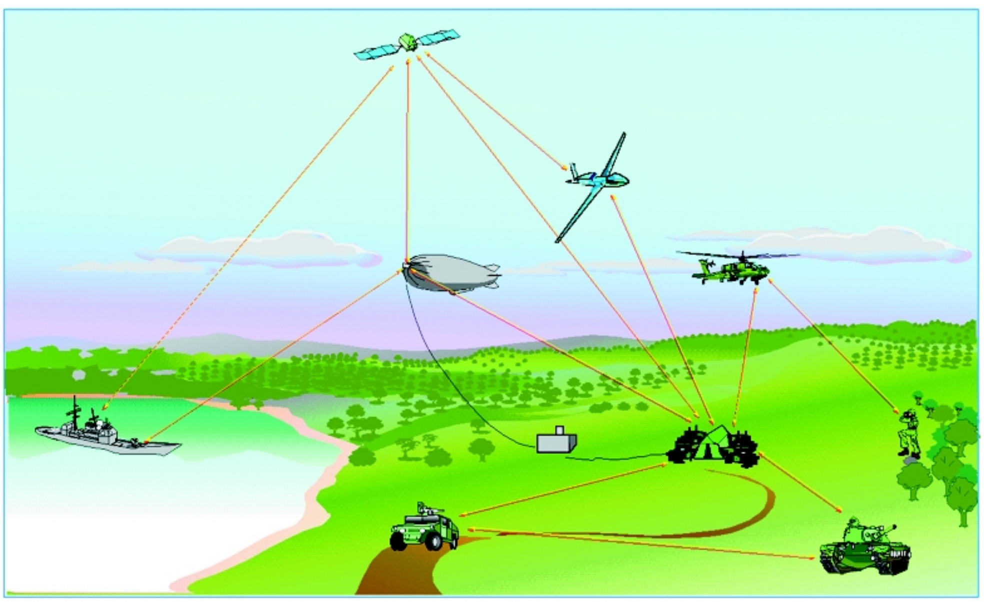


Figure 6-3: Laser Communications

Range Extension

The primary objective of this CECOM STO is to develop a tactical SHF, UAV based, surrogate satellite capability by integrating several technologies in a Range Extension Testbed. This effort will leverage the UAV Airborne Communications Relay Digital Battlefield Communications ATD development. The Range Extension STO will demonstrate intra-theater communications range extension up to 400 miles at a variety of data rates. Major technology areas to be addressed are: airborne payload (including antennas) designs, ground terminal adaptations, interoperability/compatibility and simulation. System design will be supported by an in-house satellite link analysis capability. A Communications Range Extension Test Bed will be developed to provide an adaptable testing environment. Major milestones include development of the Range Extension Testbed in FY96, demonstration of an SHF Airborne Relay UAV based Surrogate Satellite System in FY97, development of an on-board switching capability, and implementation of an airborne battlefield paging system by FY99.

On-the-Move Tactical SATCOM Technology

The goal of this CECOM STO is to develop on-the-move SATCOM ground technology for use with wideband commercial low earth orbit (LEO), medium earth orbit (MEO), and military geosynchronous earth orbit (GEO) satellite communications. In addition, Protected (Advanced EHF) Narrowband Satellite communications, compatible with MILSATCOM, will be planned for future satellite integration. Modems, protocols, coding, and antenna improvements will be developed and leveraged to achieve wideband communications on-the-move with LEO, MEO and GEO satellites. Similar technology will be developed to achieve narrowband Protected Mode communications with Advanced EHF satellites. Maximum use will be made of programmable fast recovery (from blockages) modems to allow use with multiple satellite constellations. These enhancements will provide for terminals that are small in size, weight and power consumption that rapidly recover from outages due to man made objects, terrain/ foliage, weather & other atmospheric effects. This STO will begin in FY00 and conclude in FY04. Demonstration of the Narrowband Protected mode enhancements will be conducted in FY03. Demonstration of Wideband LEO, MEO and GEO enhancements will be conducted in FY04.

Antennas for Communications Across the Spectrum

The objective of this CECOM STO is to develop, leverage, and apply emerging antenna technology to reduce the number of antennas, visual signature, and control problems. Additionally, this STO objective is to increase efficiencies and radiation patterns in the 2MHz to 2GHz. Another goal is to provide On-The-Move (OTM) SATCOM antenna capabilities in the X and EHF bands. For air and ground vehicles, Structurally Embedded Reconfigurable Antenna Technology (SERAT); and structure tuned antenna techniques (225-450 MHz) will be used. SHF and EHF low profile, self-steering, On-The-Move (OTM) antenna technology will be applied to the SATCOM applications. The design, fabrication and test of a phased array antenna utilizing ferroelectric phase shifters will be pursued. The phased array antenna will interface with the High Capacity Trunk

Radio and DSCS modems at data rates of 128 to 256 Kb/s. The antenna shall be capable of acquiring and tracking an airborne relay operating at heights to 65,000 feet or a DSCS satellite from a moving High Mobility Multipurpose Wheeled Vehicle at speeds up to 40 m.p.h. on improved roads and 10 m.p.h. on unimproved roads. A secondary effort is to develop a low cost mechanical positioner/tracker for dish antennas or static phased arrays operating initially at SHF then extending to EHF. This STO began in FY97 and concludes in FY00.

Experiments and Demonstrations

Experiments

Experimentation is the primary focus of battle laboratories. Experiments are planned, conducted, and reported by battle laboratory-led teams. The team composition is tailored to the specific experiment. Battle labs are the primary agent for all experiments, establishing requirements within their area of expertise. Experimentation is designed to:

- Support DTLOMS requirement determination.
- Support materiel requirement development.
- Provide opportunities to streamline acquisition testing and evaluation.
- Provide insights to FOC solutions.

The following space-related experiments will provide insights, analysis, recommendations, and solutions to enhance Army warfighting capabilities.

Joint/Combined Arms Precision Attack

Joint/Combined Arms Precision Attack (JCAPA) is led by the Air Maneuver Battle Lab, and supported by the Depth and Simultaneous Attack Battle Lab, and the SMDBL. The objective of this experiment is to integrate air maneuver, precision artillery fires, and space-based systems to quickly identify, track, and neutralize key enemy targets at extended ranges in order to shape the division/corps commander's battlespace. Additionally, this experiment will evaluate operational improvements gained through better communications using space assets. The experiment will be conducted from FY99-01.

Battle Command Re-engineering 2

This experiment is a collaborative effort between the SMDBL and the Mounted Maneuver Battle Laboratory (MMBL). The objective of the Battle Command Re-engineering 2 (BCR2) initiative is to quantify the value of real-time, space-based information to the Army maneuver commander. BCR2 is a follow-on experiment to an existing MMBL Battle Command Reengineering Concept Experimentation Program (CEP) effort. This architecture will provide a variety of space products such as imagery, warning, position/navigation, and communication. This capability will increase the situational awareness of the battlespace for the maneuver commander. This experiment will be conducted from FY98-99.

Joint Air and Ground Unified Awareness Experiment (JAGUAR)

JAGUAR is a SMDBL experiment to evaluate the increased performance in meeting the Theater Missile Defense (TMD) mission through improved information processing and dissemination to joint component forces. The objective of this experiment is to assess how the performance of the overall TMD mission will improve by simply sharing critical information more efficiently. The intent is to focus on sharing Intelligence Preparation of the Battlefield information prepared by analysts that will enable both the Army and Air Force to develop a better understanding of the threat TBM infrastructure. This experiment will be conducted during FY99.

SBIRS/Air Missile Defense Experiment - No Horizons

This SMDBL experiment will develop and certify a System Specific Representation (SSR) of the Space-Based Infrared System (SBIRS). This experiment was formerly referred to as "Fuser". The SSR will be used in conjunction with testbed assets (to include the Extended Air Defense Testbed) and joint experiments to determine the operational utility of SBIRS to the Army.

The goal of this experiment is to improve operational effectiveness through the fusion and sorting of missile tracking data. Data from SBIRS, along with airborne and ground sensors, will be analyzed to determine the effectiveness of Army missile systems in engaging ballistic and cruise missile threats. This experiment will be conducted in three phases beginning in FY98 and concluding in FY01.

Force Warning Experiment

This experiment will demonstrate an increased theater releaseable force warning capability using theater dissemination systems. The objective of the SMDBL's Force Warning Experiment is to operate and compare alternative systems for use in an "early warning" alert role during enemy missile attack operations. Present systems have a variety of communications problems, which delay relaying critical missile attack warning messages. A comparison of proposed systems will be made based on their ability to receive, process, and disseminate timely and accurate early warning information. A subset of the Force Warning Experiment is the Intermediate Pager Warning System which is being considered as a candidate for the Warfighter Rapid Acquisition Program.

Space Support to Deep Operations Coordination Cell

The objective of the SMDBL's Space Support to Deep Operations Coordination Cell (DOCC) experiment is to demonstrate to the Land Component Commander that optimized space support can shorten sensor-to-shooter timelines and improve planning and execution of precision attack operations. Additional objectives include: assessing the impact of current and future government and commercial space systems in direct support of the DOCC; and leveraging experience from the Force Projection TOC in using space support for targeting, cueing and warning, IPB development, planning and analysis. This experiment will be conducted from FY98-03.

Kinetic Energy Anti-Satellite (KE ASAT) Technology Experiment

KE ASAT is an ongoing SMDC Congressionally-directed experiment focused on developing interceptor and associated hardware/software technologies to negate low Earth orbit satellites. KE ASAT supports the DoD space control technology development effort. SMDC has developed and ground-tested kill vehicles with a debris mitigation device, weapons control subsystem hardware and software, and high fidelity hardware in the loop simulations. In addition, SMDC has conducted an independent review of the KE ASAT design and operational concept that minimizes satellite intercept orbital debris. Other experimental activities may include additional simulation and analysis of kill vehicle performance, developing flight qualified kill vehicles, and plans for future flight tests as approved in the DoD space control technology development effort. The experiment began in FY96, and has been funded through FY98.

Warfighter-1

The Warfighter-1 (WF-1) is an Air Force Research Laboratory-led space experiment (Figure 6-4). The Army is participating in the planning process and will be part of its execution. The experiment involves a hyperspectral imaging sensor that will fly on OrbView 4 (a commercial satellite) during late 1999 or early 2000. There will be a Mobile Ground Station (MGS) capable of in-theater satellite tasking and direct downlink. A High Mobility Multi-Purpose Wheel Vehicle (HMMWV) will function as the platform for the MGS. The WF-1 spacecraft will have an on-board, reconfigurable processing capability. The potential benefit to the Army is that it allows for an assessment of the tactical utility of a hyperspectral imaging sensor. This experiment began in FY96 and has funding through FY98.

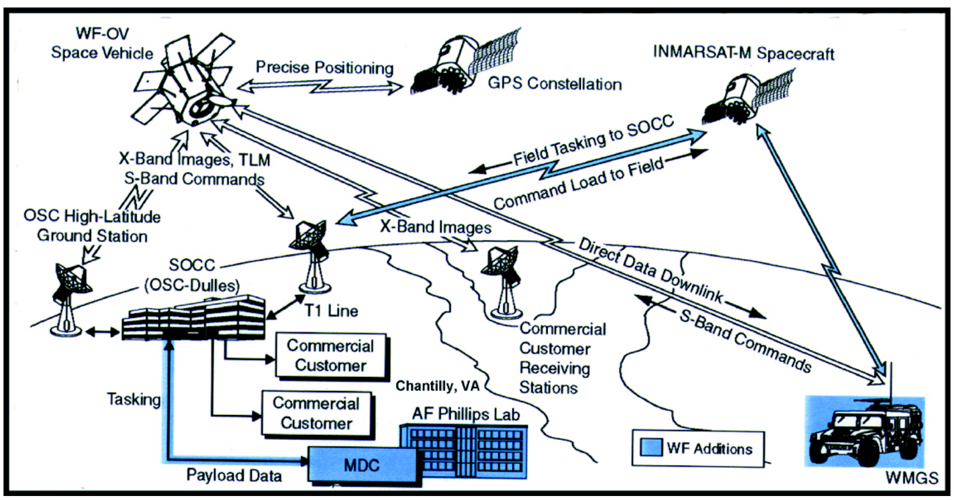


Figure 6-4: Warfighter-1 Operational Concept

Situational Awareness-Human in the Loop Experiment

SMDBL's Situational Awareness (SA) Human in the Loop Experiment (HIL) experiment will evaluate the effectiveness of space-based sensor information provided to the tactical warfighter for situational awareness. The warfighter will be able to make real-time decisions based on both intelligence and space-based sensor data. The timelines of the warfighter's decision making will be evaluated in a simulated environment. The experiment main objective is to identify useful tactical warfighter information. From this, a simulated display will be developed. This experiment will be conducted during FY99-03.

Project Stalker - Evaluating Missile Defense for the Warfighter

Stalker is an SMDBL user-friendly computer tool used to assist in locating, tracking, and destroying enemy mobile Transporter-Erector-Launchers (TELs). Stalker allows real-time analysis of tactical and intelligence data. This analysis includes a high-fidelity regional geographic database to determine possible enemy TEL operating areas. Stalker can produce real-time assessments of the acquisition, movement, and interdiction of TELs and their support infrastructure. The database is compiled by fusing intelligence data, such as satellite photos and known operational areas, with detailed digital maps of terrain, geologic features, roads and other pertinent information. This experiment will be conducted during FY98-99.

Concept Experimentation Program

The Concept Experimentation Program (CEP) is a TRADOC program providing sponsors (TRADOC schools) the ability to evaluate and capitalize on emerging technology, materiel initiatives, and warfighting ideas. The program facilitates experimentation (conducted by TRADOC battle laboratories) to determine the military potential of an idea to become a DTLOMs solution to FOCs. The following represents current space related CEPs.

Signal Support for Force XXI Tactical Operation Centers

This Battle Command Battle Laboratory (Ft. Gordon) CEP is investigating an economy of force, two-link system comprised of a tethered dirigible operating in the rear area and a UH-60 Blackhawk operating forward. The dirigible will link a TOC and the UH-60. The UH-60 will track more deeply deployed aircraft through the Grenadier Brat system (a satellite based GPS relay and display). This will provide a capability to adjust aircraft position relative to intervening terrain and maintain continuity of communications through the TOCs link to both aircraft and the dirigible. This CEP holds the potential to enhance warfighter situational awareness and to reduce fratricide. This experiment is being conducted during FY98-99 and supports AV 2010 “Protect the Force”.

Movement Tracking System/Radio Frequency Identification/Improved Combat Service Support System Enhancement

This Combined Arms Support Command CEP project will link Combat Service Support (CSS) assets, movement visibility, and CSS infrastructure beyond the traditional linear lines of communication and support in consonance with Army goals. This initiative will require space-based imaging, communication, and navigation and positioning data. This CEP is being conducted during FY98-99. It supports the concept of sustaining the force and JV 2010 focused logistics concepts by using movement tracking system and total asset visibility technologies.

Course of Action Wargaming Tool

This Battle Command Battle Laboratory (Ft. Leavenworth) CEP will enhance a current CECOM space-based infrared satellite prototype course of action (COA) analysis tool. This analysis tool allows for multiple scenario war gaming of three COAs. This effort will prototype an interactive interface to the Maneuver Control System (Prototype) Baseline system and the Eagle simulation. The multiple scenario war gaming will use the Eagle simulation now being developed by the TRADOC Analysis Command (TRAC). This CEP supports USSPACECOM Vision 2020 guidance to develop modeling and simulations to analyze the performance of proposed systems and sensors in support of the Control of Space operational concept. This experiment is being conducted during FY98-99.

Demonstrations

Demonstrations provide a means to showcase the feasibility of solving military deficiencies. These demonstrations vary depending on the level of maturity of the technology and resources assigned to proving the concept. A representative sample of space-related technology demonstrations and development efforts are reflected below.

Sensor Fusion

The Space and Missile Defense Technical Center (SMDTC), in conjunction with the Ballistic Missile Defense Organization (BMDO), is planning the development of fusion and discrimination techniques and algorithms for the Discriminating Interceptor Technology Program (DITP). This technology development began in FY96 and concludes in FY03. It will use data from laser radar and passive infrared sensors on interceptor long-range seekers to discriminate between objects, decoys, and actual reentry vehicles in space.

Eagle Vision II

Eagle Vision II (EV II) is a cooperative effort between the Army (ASPO, ARSPACE, and the Topographic Engineering Center) and the NRO to develop a test bed system that will assess the utility of providing unclassified commercial imagery to deployed warfighting commanders using in-theater direct satellite downlinks (Figure 6-5). EV II will also provide topographic and intelligence systems with unclassified panchromatic, multi-spectral, and radar imagery. The NRO will develop the system with the assistance of Army personnel who will operate the system during exercises, demonstrations, and contingency operations. EV II ground components consisting of a system tractor, an expandable trailer (including four workstations and an outrigger), and X-band antenna will be delivered in FY99. If successful, the EV II capability will be integrated into future Army TENCAP systems such as the Tactical Exploitation System, as well as a stand-alone capability for selected non-intelligence units. This test bed will be conducted through FY01.

Discoverer II

The Discoverer II program is a joint DARPA/USAF/NRO development and demonstration effort to deploy 24-48 Synthetic Aperture Radar imaging and Moving Target Indicator (SAR/MTI) satellites into low earth orbit (LEO) to provide direct tasking capability to a deployed tactical commander. Two demonstration satellites are planned to be deployed in the FY03-04 timeframe. If successful, the remaining satellites could be deployed in the FY07-10 timeframe. Demonstration objectives include the feasibility and utility of delegating collection management authority to a tactical commander, and a demonstration of SAR/MTI data downlink using lightweight satellites. The Army's key commitment to Discoverer II is in the form of a modified TES to serve as the tactical ground processor for the demonstration. SMDC will conduct additional analysis,

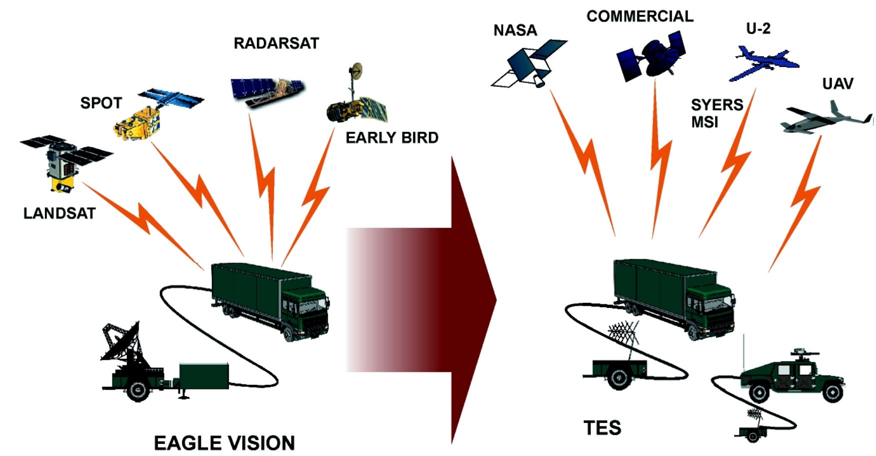


Figure 6-5: Eagle Vision II

modeling, and experimentation to develop Army requirements in support of this demonstration.

Coherent Change Detection / Interferometric Synthetic Aperture Radar Project

ASPO is investigating and evaluating the Coherent Change Detection (CCD)/Interferometric Synthetic Aperture Radar (IFSAR) Project to determine if SAR imagery can be improved by this technology. CCD is a processing technique involving the comparison of a pair of coherent SAR images from approximately the same geometry collected at two different times. The result of this comparison can aid imagery exploitation by revealing minor changes in the imaged area, such as vehicle tracks and evidence of mine or barrier emplacements. IFSAR processing compares two or more coherent SAR images collected at slightly different geometries, extracting phase differences caused by relative differences in elevation within the image scene. This process can be used to develop precise terrain elevation data suitable for the production of highly accurate maps, three-dimensional targeting data, route planning analyses, and simulated fly-through of an area of operations. The CCD/IFSAR technology will be operational in the Enhanced Tactical Radar Correlator (ETRAC) in FY99.

Terrain Extraction from National Stereo Imagery

ASPO is investigating the use of stereo pairs from NRO imaging systems to produce highly accurate digital terrain elevation data (DTED Level 3) in the field in support of immediate tactical operations. Imagery is acquired through the MIES and passed to the ETRAC for DTED processing when the latter is not on line with U-2 aircraft sensors. The algorithms being developed have the potential for application to imagery acquired from the U-2 and future Global Hawk and Dark Star UAV platforms.

MERIT Program

The Military Exploitation of Reconnaissance and Intelligence Technology (MERIT) program is a technology effort administered by the NRO Defense Support Project Office (DSPO). The MERIT program provides funds for the development and prototyping of capabilities that increase the utility and accessibility of national space reconnaissance information for the tactical operator. Most MERIT projects are for preplanned product improvements (P3I) rather then new starts. Projects selected for funding must meet MERIT criteria and address CINC specified thrust areas. SMDC/ASPO provides technical assistance to HQDA in the solicitation of Army proposals and the subsequent staffing process. The MERIT program selects projects based on the following criteria:

- Will the project improve tactical use of national capabilities?
- Does the project have joint Service application?
- Does the project involve research and development efforts?
- Does the project entail near term application of results (less than 24 months)?
- Does the project have significant application to tactical operations?

Headquarters, Department of the Army (Deputy Chiefs of Staff for Operations and Intelligence) coordinates Army participation in this program. Examples of Army sponsored projects selected in FY98 and FY99 under the Merit Program are:

FY 98 MERIT Projects

Multi-Spectral Automatic Target Exploitation System

The Multi-Spectral Automatic Target Exploitation System (MATES) is an ongoing ASPO led program to develop a system capable of taking in high resolution multi-spectral data and detecting tactical targets in wide area searches. The prototype system will have an end to end processing capability that will accept data, process it, and provide target detection as the output. This system will be a stand-alone capability, hosted on a workstation, using a commercial electronic light table for the user interface. This project is currently under contract, and is expected to conclude in FY00.

Embedded National Tactical Receiver

The Embedded National Tactical Receiver (ENTR) project is an NRO Operational Support Office (OSO) led, and ASPO sponsored effort. The objective is to fabricate a miniaturized receiver that is the functional equivalent to the Tactical Receive Equipment (TRE) that receives the national broadcast over the TRAP Data Dissemination System (TDDS). Examples of TRE include the Success Radio, the Commanders Tactical Terminal, and the emerging Joint Tactical Terminal. Current TREs are large, expensive equipment suites that perform all RF reception and filtering functions. This project will produce a single-channel receiver in a desktop computer, complete with data decryption, in a circuit card (approximately 3" x 6"). The Hayfield multi-chip module, running the Key Generator-96 algorithm will perform the decryption. Software to control the receiver and perform the necessary filtering functions will be hosted on the computer. The ENTR is an ongoing effort with delivery planned for FY99. ASPO will receive two prototype receivers.

FY 99 MERIT Projects

PCMCIA Embedded National/Tactical Receiver

The PMCIA Embedded National/ Tactical Receiver (PENTR) is an OSO led, ASPO sponsored project. The PENTR is a follow-on effort to the ENTR. The goal of the project is to fabricate a laptop personal computer (PC) Card version of a TRE system such as the Success Radio, the Commanders Tactical Terminal, and the emerging Joint Tactical Terminal. Current TRES are large, expensive equipment suites that perform all RF reception and filtering functions. The PENTR will produce a four-channel receiver, complete with four channels of data decryption, in a Type III PC Card. It will take advantage of the increased functionality of small laptop processors and use their inherent computational power to perform system and receiver control and filtering functions.

Battlespace Weather Characterization and Data Fusion

The Battlespace Weather Characterization and Data Fusion program is a joint Army and Air Force effort. The objective of the program is to perform battlespace weather characterization by developing and distributing high-resolution cloud and aerosol information products built from data provided by high-resolution sensors. This data will be provided to tactical units during crises and selected exercises. The program is expected to begin in FY99 and conclude in FY00.

Integrated Sensor Picture and Dissemination

The Integrated Sensor Picture and Dissemination (ISPAD) project is an ASPO led effort. The objective of the project is to provide TENCAP data to tactical users at brigade echelons and below, special operation forces, and other Services. ISPAD provides an integrated picture of available national and theater sensor coverage and provides rapid collateral dissemination over limited bandwidth communication paths. The ISPAD is a client/server implementation and will integrate ISPAD server software into existing/emerging TENCAP systems. Client modules will be integrated into existing tactical laptops or C2 terminals, such as the Battle Command System ACTD Operations Intel Workstation. The server responds to remote user queries by generating a sensor coverage overlay for the area of interest, formatting the overlay into a message, and delivering the message over existing communication paths. The server automatically performs smart push of products corresponding to ISR requests or essential elements of information. This project is expected to begin in FY99 and will last two years. At present, only the first year of the project is funded.

Embedded GBS Receiver

The Embedded GBS Receiver project is an OSO led, ASPO sponsored effort. The objective of the project is to miniaturize the current GBS receiver components (i.e. Integrated Receiver/ Decoder (IRD), a data bridge, key generator, and a router) with a product that performs all these functions on one PC circuit card. This effort takes advantage of the new NSA decryption chipsets that replaces older, bulkier encryption devices. This project will result in a significant reduction in the size, weight, and power required for receipt of data broadcast via GBS. The project is funded (12 month effort), but not yet under contract. ASPO will receive two prototype systems upon completion of the project.

Advanced Technology Demonstrations (ATDs)

ATDs are risk-reducing, integrated, "proof of principal" demonstrations designed to assist near-term system developments in satisfying specific operational capability needs. Testing is conducted in a real and/or synthetic operational environment, has a finite schedule, and typically lasts five years or less.

Battlespace Command and Control (C2) ATD

The objective of this CECOM ATD is to demonstrate, through modeling, simulation, and experimentation, critical solutions that will lead to demonstrable C2 and battlefield visualization (BV) enhancements. Data from space sensors will be used to enhance situational awareness. These capabilities will be integrated into C4I system architectures at battalion through division. This ATD will also explore the integration of C2/BV software into Corps and Echelons Above Corps (EAC). This demonstration began in FY96, and will be completed in FY00.

Digital Battlefield Communications ATD

Digital Battlefield Communications (DBC) is an ongoing CECOM ATD program that exploits emerging commercial communication technologies in support of multimedia communications in a highly mobile dynamic battlefield environment. The DBC ATD supplements legacy military communications systems, which are unable to keep pace with the rapidly increasing demand for communications bandwidth and global coverage in support of the Digitized Battlefield and split-based operations. It involves an integrated communications infrastructure that utilizes commercial protocols and standards to achieve global interoperability. This program has demonstrated Direct Broadcast Satellite technology in support of JWID and TFXXI. Low profile SATCOM antenna technology products for both military (UHF, SHF), commercial (C, Ku), and SATCOM On-The-Move (OTM) from tactical vehicles is being demonstrated. In FY99, an integrated phased array antenna will be demonstrated for the Radio Access Point. Work will continue on a full sized phased array antenna to address multibeam satellite high data rate communications on the move. This ATD began in FY95 and will conclude in FY99 with the insertion of appropriate technology products in Corps XXI AWE and JWID 99 in support of high capacity digitized communications and split-based operations.

Universal Transactions Information Systems ATD

The Universal Transactions Information Systems is a proposed CECOM ATD that focuses on mobile communications to support a Strike Force in a rapidly expanding theater of operations. The ATD will leverage, develop and integrate a transparently adaptive, network aware, secure, and robust communications architecture that will provide scalable mobile communications. The use of airborne relays and satellite communications will be integral to the architecture to meet range extension requirements. The technologies developed will be transitioned to the Warfighter Information Network - Tactical (WIN-T), MILSATCOM, and Tactical Radio Communications Systems (TRCS) Program Managers. This ATD may potentially begin in FY00, and conclude in FY04.

Advanced Concept Technology Demonstration

The primary objective of the Advanced Concept Technology

Demonstration (ACTD) is to accelerate and facilitate application of mature advanced technologies to solve important military problems. ACTDs provide new operational capabilities that will make a difference to the warfighter. The Rapid Battlefield Visualization (RBV) ACTD is the only ACTD with a space focus. A description of the RBV ACTD is reflected below.

Rapid Battlefield Visualization ACTD

The purpose of the Rapid Battlefield Visualization ACTD is to demonstrate technologies involving digital terrain data (DTD) merged with intelligence data to enhance battlefield visualization. The Army currently does not have high resolution digital terrain data needed for worldwide mission planning and execution. This CECOM-led ACTD will also demonstrate semi-automated feature extraction capabilities to provide rapid terrain feature data for contingency operations. This demonstration will be conducted during FY97-00.

Advanced Concepts and Technology II (ACT II) Program

The ACT II program is designed to encourage application of mature and maturing commercial technologies to address immediate Army concerns. The following are space-related ACT IIs.

Automated Feature Extraction from Multisource/Multispectral Imagery

This is a Corps of Engineer (Topographic Engineering Center) sponsored, and Northrop Grumman Corporation-executed ACT II project. This project proposes an automated system to augment and refine existing National Imagery and Mapping Agency and Topographic Engineering Center baseline imagery by generating “hasty data” directly from Multispectral Imagery (MSI) and IFSAR. Grumman proposes to produce combat ready data supporting predictive intelligence and proactive engagement activities such as cross country mobility and trafficability. This project is being conducted during FY98-99.

Building Feature and Content Prediction Using Knowledge-Based Sensor Fusion

This ACT II project is a CECOM sponsored and Intelligent Investments Corporation executed effort. This concept will utilize sensor fusion, compact sensors, knowledge-based (expert) systems, and reasoning under uncertainty to address the question, “How well can unobservable features and contents of buildings be predicted?” This concept will fuse dissimilar data with external data (known building features and contents, Geographic Information System (GIS), GPS, and intelligence to dramatically improve situational awareness in urban terrain. This project is being conducted during FY98-99.

Combat Service Support Worldwide Web Proposal Enabler Tools

This ACT II project is a CECOM-sponsored and Advanced Communication Systems (ACS), Inc. executed proposal. The purpose of the project is to demonstrate the power of integrating browser tools coupled with web-based Combat Service Support (CSS) programs to complement the Army’s goal of a Combat Service Support Worldwide Web (CSS WWW) internet solution. Selected commercial and ACS customized products will be demonstrated. This demonstration will include broadcast technology, LEO personal communication services, and geosynchronous satellites. This project supports the Army's Enterprise Strategy that requires integration and interoperability of CSS systems to support Force XXI's capabilities-based, flexible strategy. This project is being conducted during FY98-99.

Army Space Exploitation Demonstration Program

The Army Space Exploitation Demonstration Program (ASEDP) is an SMDC managed program initiated in 1987 to leverage the commercial community's space technology advances. Since that time the ASEDP has significantly enhanced the Army's warfighting capabilities through utilization of space-related technologies. The Lightweight GPS Receiver (SLGR) employment during Operation Desert Storm resulted from ASEDP. The objectives of the ASEDP are to:

- Educate commanders on the use of space-based assets to enhance Army operations.
- Assist in defining requirements for Army development.
- Demonstrate new technology for possible further development.
- Influence the design and use of future space systems.
- Provide rapid prototyping in support of contingency operations.

FY 98 ASEDP PROGRAM STATUS

Twenty SMDBL Concept and Operational demonstrations were approved for execution in FY 98. Of these 20 demonstrations, funding was available for only eight. One program, the Clark NASA imagery program, was terminated in March 1998 due to a spacecraft failure. Listed below is the status of the remaining seven funded demonstrations.

Global Broadcast Service

A Global Broadcast Service (GBS) theater injection capability was demonstrated as part of the Division Advanced Warfighter Experiment (DAWE) at Ft. Hood in November 1997. The objective is to demonstrate that direct broadcast satellites can provide high speed distribution of information from all echelons of command to support tactically-deployed, operational units. The GBS demonstration was completed at the end of FY98.

Global Broadcast System/Information Dissemination Management (GBS/IDM) Demonstration

During FY98, CECOM, Space Systems Ku band Uplink and Broadcast Management Center (BMC) focused on the integration of space derived information products into the appropriate Army Battle Command System (ABCS) platforms. As part of this overall effort, partnerships have been formed with PEO, C3S and the Central Test Facility at Fort Hood, Texas to ensure a totally integrated program thrust. The FY99 effort involves merging the Tactical Information Dissemination Management (T-IDM) program with the PEO, C3S Map Server Initiative to demonstrate the downlinking of large map based files from the National Imagery and Mapping Agency and broadcasting these files to the First Digitized Division (FDD) in Ft. Hood, Texas. To perform this technical integration, CECOM will employ the Ku band Uplink and BMC to replicate the joint GBS satellite testbed, as well as hardware and software that replicates the ABCS interfaces to the command and control platforms in the FDD. This demonstration will begin in FY99 and conclude in FY01.

Deployable Weather Satellite Workstation/Meteorological Automated Sensor and Transceiver

The objective of ARSPACE's Deployable Weather Satellite Workstation (DWSW)/Meteorological Automated Sensor and Transceiver (MAST) demonstration is to demonstrate the ability to fully exploit all imagery data from geostationary and LEO meteorological satellites (METSATs) along with tactically deployed, ground-based environmental sensors. This system will enhance the commander's situational awareness through the application of real-time, high-resolution METSAT imagery and forward-area weather sensor data. This program was demonstrated in the DAWE and considered highly successful. The program has been selected to continue in the First Digital Division and Corps AWE exercises. This demonstration will conclude in FY99.

Army Battle Command System (ABCS) Integration

This program is a Battle Command Battle Laboratory (Fort Leavenworth) and SMDBL effort to integrate space information into current and future Army Battle Command Systems. This program is a multi-year effort (FY98-00) and will serve as a model for integration of future ASEDP experiments. The initial effort is the integration of weather data into the Maneuver Control System (MCS). Overall, ABCS integration is a PEO C3S/CECOM led effort in support of the First Digitized Division.

Low Earth Orbit Communications

Low Earth Orbit Communications (LEOCOMM) is a small, lightweight satellite communications package that can be carried into battle by the warfighter. It provides two-way communications, and when used with embedded GPS, LEOCOMM provides an additional Blue Force Tracking capability. The LEOCOMM demonstration will be conducted during FY98-00.

DirectPC

DirectPC uses the commercial Galaxy IV satellite to broadcast high-speed data and video to a small, lightweight receive and display device. It provides low cost, high speed Internet access using a standard WWW browser. The objective is to demonstrate the "smart push" of tactically relevant information to soldiers. The DirectPC demonstration was completed at the end of FY98.

Tactical Automated Situation Receiver

The Tactical Automated Situation Receiver (TASR) combines three commercial off-the-shelf technologies into one package: wireless radio modem for two-way messaging, a hand-held computer, and a GPS receiver. The objective is to provide alert warning and battlefield intelligence data that is broadcast over terrestrial communications or a mobile satellite system. The system uses positioning data from GPS to determine if an alert broadcast is relevant to a specific area on the battlefield, and if so, displays the danger information for the user. The TASR demonstration will continue through FY99.

Civil/Commercial Imagery Systems

Civil/Commercial Imagery Systems (CCIS) is a multi-phase, multi-year program to demonstrate the tactical value of civil and commercial satellite imagery to the warfighter. The purpose is to measure the utility of direct warfighter tasking and downlinking. The Eagle Vision II and Warfighter I programs will support CCIS. The CCIS demonstration is being conducted during FY98-99.

FY 99 ASEDP PROGRAM STATUS

The ASEDP is undergoing a change in focus for FY 99 and beyond. The Space and Missile Defense Command has determined that the most appropriate method for warfighter space technologies experimentation is via existing future Battle Command Systems. The "prototype" for this new focus is the FY 98 ABCS Integration project. In this effort, the SMDBL has partnered with BCBL-Leavenworth to demonstrate enhanced situational awareness based on the introduction of timely weather information into the MCS. Principle goals for future ASEDP experiments include partnering with other TRADOC battle laboratories and providing space information to soldiers via Battle Command architectures. ASEDP experiments approved for FY99 are:

- Deployable Weather Satellite Workstation (DWSW)
- Meteorological Automated Sensors and Transceiver (MAST)
- Mobile Satellite Services (MSS)
- Tactical Vehicle Smart Communications Switch (TAVSCOMS)
- Soldier Warning and Messaging (SWAM) System
- Tactical Automated Situational Receiver (TASR)
- Civil/Commercial Imagery Systems (CCIS) Exploitation
- Space and Information Analysis Model (SIAM)
- GPS Mapping and Navigation
- ABCS Integration
- 3D Display
- Global Broadcast System/Information Dissemination Management Demonstration

Exercises and Training

Exercises (Joint, CINC and Army) present opportunities to conduct DTLOMS experiments in a live environment to collect data, observe unit operational procedures, and to evaluate interoperability issues regarding space initiatives. The use of models and simulations to recreate actual equipment such as TOC displays and communications nets creates a Synthetic Battlefield Environment (SBE) that permits the creation of numerous and varied events (Figure 6-6). This combination tests the full range of space initiative alternatives at very low cost when compared to fully live experiments. The information derived from these exercises range from instrumented data sets to lessons learned reports, all of which help identify DTLOMS solutions and in the process possibly raise other DTLOMS issues. Space supported exercises are particularly well-suited to gain insights on issues pertaining to DTLOMS.

These capabilities can be used to develop virtual prototypes, conduct advanced concepts and analysis, and execute training, exercises and military operations. The ability to take a space concept and virtually prototype it in a simulation environment and link this environment to actual Tactical Operations Centers is essential. These links are tied to actual command and control systems to examine the validity or feasibility of space concepts. This capability can also be used to conduct leader and soldier training. Simulation environments linked to real world C2 systems allow for mission planning and rehearsal, tactics, techniques, and procedures (TTPs) development, after action reports and sustainment training.

Representative exercises that offer opportunities to evaluate space initiatives have included: CINC exercises, Army AWEs, Battle Command Training Program (BCTP) Warfighter events, and Joint Task Force Exercises. Specific annual events include participation in TRADOC-sponsored Army experiments, Prairie Warrior, Roving Sands, Ulchi Focus LENS, Unified Endeavor, Corps BCTP, Corps AWE, II Corps WFX, Atlantic Resolve/Joint Project Optic Windmill, Cascade Peak, and others. Satellite Architecture for Advanced EHF, Gapfiller, X/Ka are being worked for the Army by PEO C3S, CECOM S&TCD, PM Milsatcom, PM DCATS, and TRADOC TSM for SATCOM.

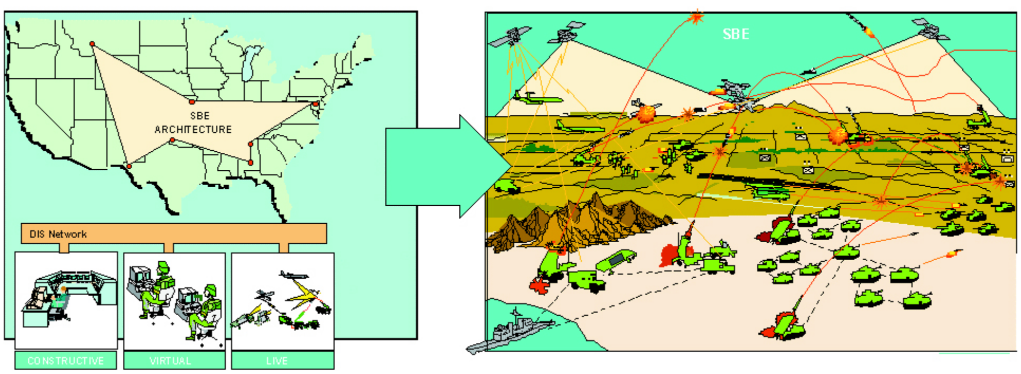


Figure 6-6: Synthetic Battlefield Environment (SBE)

Modeling and Simulation

The Space and Missile Defense Modeling and Simulation (M&S) Working Group (SMD MSWG) develops, integrates, and implements the comprehensive Modeling and Simulation strategy for the SMDC. The SMD MSWG ensures that appropriate models and simulations are available when needed for development, acquisition, deployment, and life-cycle support. This section outlines current and proposed space model and simulation initiatives.

Satellite Architecture Requirements Definition Tool

This SMDBL project supports the Requirements Definition Process to simulate, identify, and improve the Army's requirements definition for a critical Space Architecture that supports the warfighter. This effort will provide the simulation tools necessary to study satellite architecture questions. This project will be conducted during FY99-00. It potentially affects all Army capabilities. All model and simulation requirement documents will be approved IAW AR 71-9 and TRADOC Pam 71-9.

Mission Rehearsal, Training Exercise Proof of Concept Experiment, and Related Tools

This SMDBL project supports the warfighter in the operational and training areas by taking digital space products and translating them into a simulation scenario. The warfighter can use the scenario in support of quick operational mission rehearsal and training activities. Existing imagery feature extraction routines will be improved and multiprocessor techniques employed to speed imagery products. The conceptual Air Defense and Intelligence Module (ADIM) will be completed to provide the summarization of an expected Red Threat deployment through imagery or other intelligence sources to support modeling and simulation applications. This modeling and simulation project will be conducted during FY99-00.

Imagery Intelligence Testbed

The Imagery Intelligence Testbed (ITB) is an SMDBL Modeling and Simulation tool development effort that will permit experimentation (constructive and virtual simulation) and analysis of the military utility (strategic, operational, tactical) of space-based ISR sensors. This effort supports the development of requirements for space imagery products. It will allow for the exploration of different types of space imagery data, resolution requirements, response time and the architecture required to support the warfighter.

The ITB will support experiments involving imagery products such as Battle Command Reengineering 2 Initiative and the Hyperspectral Imagery Program. The ITB will emulate the NRO's future Imagery Architecture in a modeling and simulation environment that allows for technical and tactical trades between commercially available imagery. Additionally, analysis and experiments regarding hostile nations' ISR capabilities against US forces and the resulting consequence of US exposure can be determined. This modeling and simulation project will be conducted during FY98-03.

Optical Data Analysis Technology Program

The Space and Missile Defense Technical Center, in conjunction with BMDO, is implementing and supervising the Optical Data Analysis (ODA) technology program that supports both current and future developments of missile defense systems for theater and national missile defense applications. The ODA program is providing support to the SBIRS LEO office in the development of threat target models to support the development of the Brilliant Eyes Simulation (BESim) tool.

TENCAP Modeling and Simulation Program

ASPO has established an effort to identify the tools needed to design or modify M&S tools in support of Army warfighter tactical exploitation of space and SMDC decision-making regarding space and missile defense. ASPO will conduct M&S activities to reflect TENCAP systems and concepts within present and future simulation environments such as the Joint Simulation System and the Intelligence and Electronic Warfare Tactical Proficiency Trainer.

Studies and Analysis

Studies and Analysis are central to examining DTLOMS requirements prior to experimentation. Studies and analysis provide the framework in which battle lab experiments are conducted.

Space Sensor Concept of Operations Analysis

The Space Sensor Concept of Operations Analysis is a planned SMDBL FY99 effort to evaluate concepts for proposed space sensor systems using models and simulations. This project will involve analysis of sensor performance, communication links, and dissemination of information to the tactical warfighter. Actions taken by the warfighter upon receiving imagery data such as analysis, taskings, and dissemination will be modeled. This analysis will be conducted during FY99-03.

Environmental Effects on Sensors

This SMDBL study will determine weather, sun angles, and other environmental effects on airborne sensor performance. Sensor platforms include high altitude unmanned aerial vehicles (HA-UAVs) and satellites. This project involves analysis of airborne sensor performance based upon wavelength selection, atmospheric attenuation, cloud density, and other weather obstructions. This study will be conducted during FY99.

Missile Alert Broadcast System

The Missile Alert Broadcast System (MABS) is an SMDC-nominated joint feasibility study (JFS) that addresses TMD early warning notification and sensor-to-shooter timeline deficiencies. MABS leverages the Joint Tactical Information Distribution (JTID) network's reporting of TBM launch and impact point predictions. MABS responds to data from DSP satellites, terrestrial joint systems such as JTAGS, and the Airborne Warning and Control System (AWACS). This information is provided to commanders in a timely manner to support passive and active defense, and attack operations. The MABS is a proposed modeling and simulation, and joint test and evaluation (T&E) effort that began its concept phase in FY97. If the joint feasibility study is approved in FY99, a three-year joint T&E will be conducted ending in FY02.

Summary

In support of Army modernization efforts, experimentation is key to gaining insights to operational issues and potential DTLOMS solutions. (See Figure 6-7.) With the formal creation of the SMBDL, space-related experimentation will now have greater focus and increased TRADOC visibility. Numerous experiments and analysis-based initiatives are ongoing within the space community that will potentially impact future space-based capability requirements. A summary of the initiatives (technology developments, demonstrations, and experiments) and their approved FOCs is provided in Annex E.

Demonstrations are currently planned that will address the warfighter need for near-real time receipt of space products to enhance situational awareness. Many of the initiatives currently planned or underway support various Army initiatives, but especially those dealing with information management and superiority. The results of these initiatives must be communicated throughout the Army, not only to avoid duplication of effort, but also to improve awareness of potential new concepts and technologies with very wide-ranging implications.

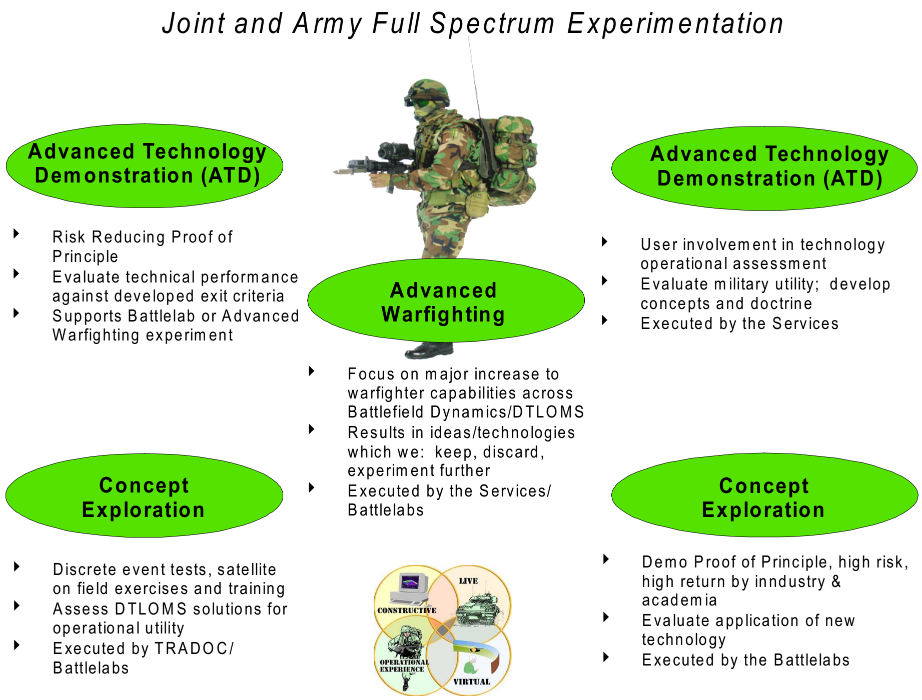
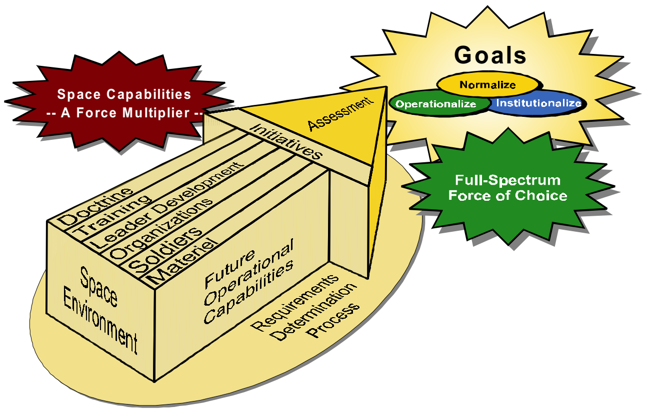


Figure 6-7: Joint and Army Full Spectrum Experimentation

The Army must continue to ensure that efficiencies are obtained by combining and integrating space experiments and technology initiatives where appropriate. The Army must also continue to work closely with DoD (especially Air Force), NRO, and commercial space providers to ensure that Army requirements are integrated, when feasible, into the design of new military space systems. Collectively, space initiatives provide an azimuth to guide combat and materiel development, and science and technology communities in meeting space needs for future Army forces.

Chapter 7: Capabilities Assessment

DTLOS on track; Materiel needs focus.



Introduction

This chapter presents an overall assessment of the Army's existing and planned capabilities and initiatives in the Space mission areas. This assessment provides the basis for identifying shortfalls and making future investment decisions.

Assessments are represented as Green (adequate), Amber (marginal), or Red (inadequate) and are grouped into three categories: **non-materiel activities** (Chapter 4), **materiel activities** (Chapters 5 and 6 and Annexes C and D), and **Army operations**. This process considers the adequacy of DTLOS or materiel solutions to meet the Future Operational Capability (FOC) needs. The rating criteria are qualitative and are described in Table 7-1.

Rating	Non-Materiel (D, T, L, O, S)	Materiel (M)
Green	Resourcing and/or Execution Adequate to Meet Mission Needs	Density and Capability Adequate
Amber	Capability to Meet Mission Needs Marginal	Density or Capability to Meet Requirements Marginal
Red	Resourcing and/or Execution Inadequate	Asset Capability or Density Inadequate

Table 7-1: Rating Criteria

Methodology

The seventeen FOCs approved for space are the basis for this assessment. A snapshot of planned DTLOMS initiatives for each FOC in the short-term (FY00-05), mid-term (FY06-11), and long-term (FY11-25) is in Annex C. The life cycle actions shown for each FOC includes all significant Army activities and initiatives. Additionally, key cooperative "partnership" activities, e.g., NAVWAR, are included.

For each specific space FOC, the chart shows those current, planned, or projected initiatives within the DTLOMS domains that will impact FOC achievement. Additionally, the charts in Annex C reflect external events expected to affect the realization of Army capabilities. These events are depicted "above the line" of DTLOMS activities and represent technology, commercial space actions, and national policy and guidance for which the Army is not directly responsible. Regarding policy, the Army Space Requirements Determination Process draws its initial direction from key national, DoD, and joint policy documents. These documents define the roles and missions of the armed forces and reflect the military's required capabilities in space. There are certain external factors or events—either as yet undecided, unfunded, or currently not stated in national policy—within the scope and timeline of Army Space FOCs which may prompt a re-evaluation of the Army's DTLOMS requirements and solution sets. An example of such an action could be a decision to support and fund space weaponization.

Non-Materiel Space Capabilities

Overall Assessment

The overall assessment for DTLOS in 2005 is Green. Shortfalls in the non-materiel domains are currently being systematically addressed. Solutions now in conceptual form will be executed within the short-term. A key factor to DTLOS success in this time frame was the designation of SMDC as the specified proponent for space. This action supported a consolidated and integrated approach to solving space issues. DTLOS solutions will continue to be assessed and may change beyond 2005. This process will consider the introduction of new equipment and changing policy.

Doctrine Assessment

To achieve a Green rating by 2005, the space doctrinal process must be normalized throughout the Army by completing the first iteration of new space concepts and doctrine. This process requires completion of the following actions (in order of priority):

- Update the Army's space FOCs and space concept (TP 525-60).
- Update the Army's capstone space manual (FM 100-18).
- Incorporate Army space doctrine within other Army and joint doctrinal manuals.
- Horizontally integrate space doctrine within the Army.

- Incorporate space play into exercises and wargames at the operational and tactical levels.
- Advance the mindset in the Army that space exists to support the land warfighter.
- Capture and analyze the space lessons learned from exercises and wargames and incorporate them into space doctrine.
- Develop new space TTPs as required.

Actions are underway to address the first three bullets (see Table 4-1). Specifically, the Army space FOCs and space concept will expand the scope of the desired capabilities to include all space operations. Revision of FM 100-18 is in progress to incorporate the doctrinal changes from the revised Army FM 100-5 and the new joint space doctrine (JP 3-14). Army space operations are being documented in other key Army and joint manuals. These initiatives lay the foundation to institutionalizing and operationalizing space doctrine. Therefore, the top three priority actions to achieve a Green rating are underway. Because the remaining actions need to be accomplished, the current rating for space doctrine is Amber.

In order to address shortfalls in the remaining areas, the Army must first identify a mechanism to horizontally integrate doctrine with space implications. The space ICT doctrine working group, composed of the six branch proponents in Figure 3-1 can provide such a mechanism. This effort will also help to alleviate the resource constraints faced by all TRADOC doctrinal proponents. Second, to operationalize space, we must develop doctrine to support the space staff officer positions (FA 40) in the corps and division staffs. This will be done in conjunction with the development of a TTP that describes corps space operations. Third, the Army must incorporate space play scenarios into the Army Experimentation Campaign Plan (AECP), Battle Command Training Program (BCTP), and CINC exercises, and incorporate lessons learned from these exercises into doctrine as appropriate.

Accomplishing these doctrinal actions will help to advance the mindset that space is focused on the land warfighter.

Training Assessment

To achieve a Green rating by 2005, the Army must: standardize the training process throughout TRADOC schools; integrate space capabilities into major exercises and AWEs; and raise the awareness of the increasing role of space through modeling and simulations. This process requires the completion of the following actions:

- Update facilities and research libraries to a higher cognizant level of space.
- Develop core curricula and an encompassing Space Operations Officer course that, when brought to fruition, analyzes space capabilities and limitations.
- Integrate space capabilities into major exercises and Advanced Warfighting Experiments (AWE).
- Incorporate the efforts of SMDBL, ARSST, ASEDP and other initiatives to normalize space.
- Using the Center for Army Lessons Learned (CALL), capture the lessons learned from ongoing activities and use the results to further reform the

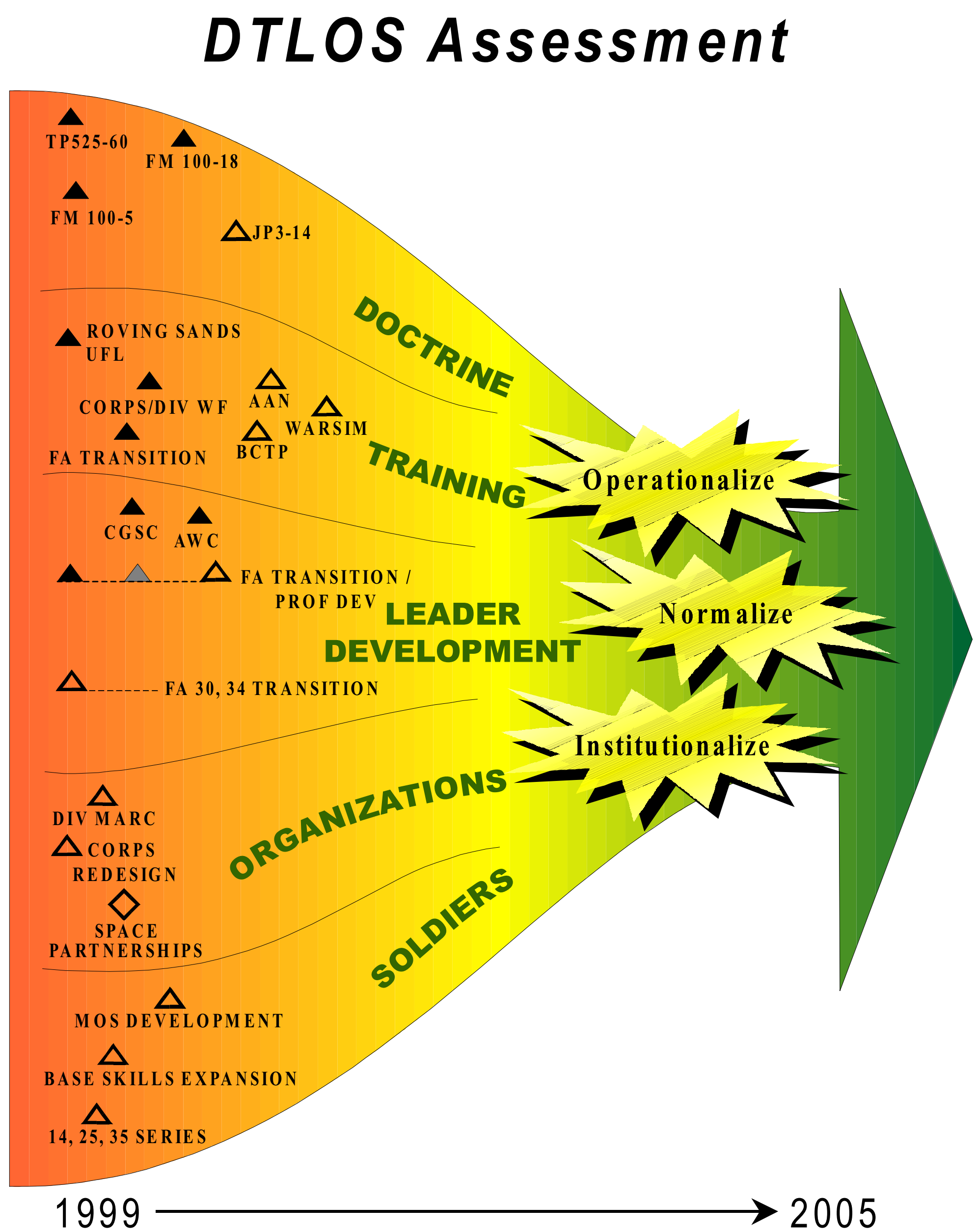


Figure 7-1: Non-Materiel Assessment

program of instruction (POI) and curriculum development.

- Advance the mindset through education and training in the Army that space exists to support the warfighter.

Currently, space related training is integrated into the core curriculum of the individual TRADOC branch schools IAW programs of instruction developed by the branch proponents and approved by TRADOC. Such instruction is branch-unique and focuses most heavily on the space enablers to the branch mission. A standardized curriculum for addressing space operations is being developed for use at all officer basic and advanced courses within TRADOC. This will ensure a degree of standardized knowledge throughout the officer corps. Additionally, space capabilities and operations are being integrated into major exercises such as Prairie Warrior, Roving Sands, Ulichi Focus Lens, and Corps Warfighters from division to theater level. Furthermore, in an effort to meet the Army's training objectives in space awareness, resources from the battlelab have been dedicated to effect technical advances and other simulation tools that replicate space capabilities and limitations. Actions are underway to achieve a Green rating, but since not all objectives have been met, the current rating for training is Amber.

Although current efforts are underway to fulfill a Green rating by 2005, there are various challenges that need to be addressed before this can be achieved. The first challenge to be met is establishing a standardized core curriculum throughout TRADOC schools and the proponents. Until a space standardized curriculum is developed and implemented Army wide, most space education received will be done at random and will be subject specific, the exception being CGOSC, where space education is offered as an elective. The course is very comprehensive in material; however, only a small number of students elect to take it. Secondly, from an operational perspective, space is still considered an unknown entity and not fully utilized by commanders. However, advances are being made by incorporating space play scenarios into exercises and warfighters. The Battle Command Training Program is helping to heighten space awareness by emphasizing space products during training. Lastly, in an effort to inject realism into current scenarios, the Battle Lab is diligently working to develop new technologies and simulations to replace outdated systems being used today. WARSIM 2000 will significantly enhance space capabilities when it is fielded.

Leader Development Assessment

Leader Development is being approached from several perspectives ranging from development of new Programs of Instruction (POI) to the creation of Functional Area (FA 40) Space Operations. The Army, working through SMDC, has determined that to produce space literate officers by 2005 the following areas need to be more integrated into the Army cycle:

- Emphasize space instruction at all levels of education for officers.
- Actively pursue implementation of the Space Operations Officer (FA 40).
- Enhance the capabilities of officers awarded the 3Y (Space Activities) ASI.

As previously mentioned, space instruction is being taught at the basic and advanced courses at the fundamental level with more advanced instruction applied at CGOSC and SSC. Again, once a standardized curriculum (being developed now) is institutionalized in the "schoolhouses", standardization will be achieved in the officer corps. PERSCOM and SMDC are working actively to institutionalize the new Functional Area 40 (Space Operations Officer) to exploit the capabilities of space systems. These officers will bring capabilities and knowledge for application of space-based products to support commanders in the 21st Century. Presently, the 3Y ASI, Space Activities, provides officers with space knowledge who can perform various

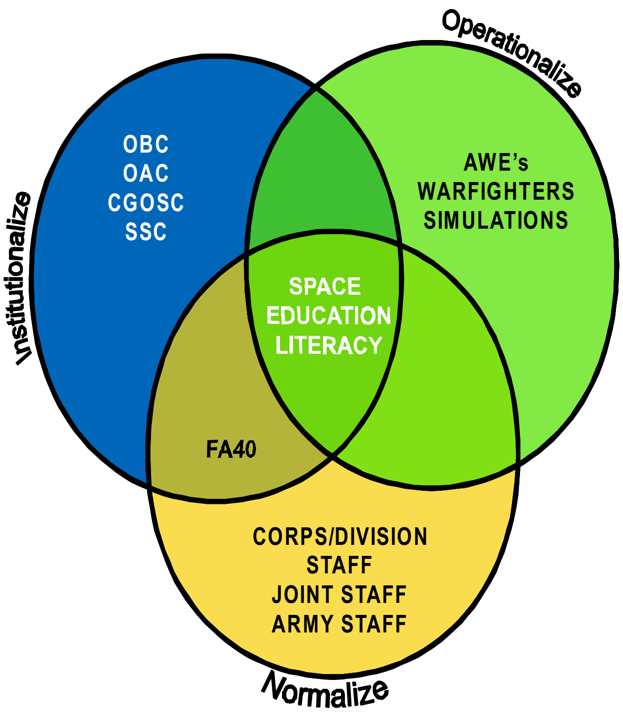


Figure 7-2: Training and Leader Development

missions from formulating space policy to preparing a space analysis for the commander. The 3Y ASI program enables the Army to maintain a broad base of space expertise in staff positions.

Challenges to the implementation of Space Operations Officers include Army Force Structure limitations such that there will be a continuing need for more space literate and experienced officers in staff positions than there are available FA 40 officers.

Organizations Assessment

To achieve a Green rating by 2005, the organizational process must be normalized throughout the Army by following regulatory guidance and participating in ongoing initiatives for evolving to the next level. A major, multi-phased effort for ensuring the Army's total involvement in space operations is in progress through the Force XXI Corps Design Analysis initiative:

- A concept for a space operations organization is being developed and will be staffed for approval.

- Through the Corps Design Analysis process, ensure Functional Area (FA) 40 (Space Operations) officers are included in Force Structure recommendations in the right quantities and in the right organizational "shape". Additionally, and as a separate action, an Army DCSPER Process Action Team (PAT) will work integration of new Officer Career Field functional areas (in include FA 40) into Army Force Structure. This PAT will convene and work issues between January and May 1999.

- Within the construct of Corps Design Analysis, develop Unit Reference Sheets (URS) that outline the numbers of personnel required (and equipment that supports them). Develop numbers as accurately as possible and review/ refine continuously throughout the process.

- Develop and submit the Force Design Update (FDU) package. This is the semi-annual process used to obtain CSA approval for new force designs as well as changes to existing force designs. FDU serves as the link between development of a URS for a new or changed design and the development of a Table of Organization and Equipment (TOE).

- Once the TOE is approved, it competes with other Army Force Structure recommendations in the Total Army Analysis (TAA) for resourcing.

In the Corps Redesign process, all activities will be submitted as an entire package within the guidelines in existing regulations. Over the longer term, the need for operationalizing space at the tactical and land component commander levels will be examined. SMDC has initiated a manpower requirement study to develop a space operations cell within the division headquarters. The process for integrating a space organization into the Army's force structure is underway. However, until the future organizational structures and content are approved, US Army Space Command has within its structure Army Space Support Teams (ARSSTs). These teams are organized and equipped to deploy with each of the current Army Corps to bring Army space capabilities to the warfighter.

Because the FDU, TOE, and TAA processes occur cyclically for out-year resourcing, timing and thorough coordination are critical. Additionally, close coordination with the other DTLOS realms is paramount to ensuring parallel progress and evolution.

Soldiers Assessment

The normalizing of space will require that all soldiers become increasingly familiar with space systems and products. This process should begin with inclusion of space familiarity into Advanced Individual Training for all soldiers. No dedicated MOS for space is being pursued; soldiers assigned to space positions or who work primarily with space systems will do so within their primary MOS.

Expansion of MOS skills is planned for those MOS series most likely to work within the space context, beginning with Signal and Military Intelligence series, and then Air Defense and Field Artillery. Further expansion will occur as identified and as necessary.

Materiel Space Capabilities

Overall Assessment - Materiel

The preponderance of DTLOS solutions and activity fall within the short term. Materiel solutions, on the other hand, extend to the out-years. Consequently, the assessments for the "M" in DTLOMS reflect ratings for near-, mid- and far-terms rather than only the near-term. Adequacy of materiel solutions will be assessed by the mission areas described in Chapter 5 and are repeated here for reference:

- Communications
- Intelligence, Surveillance, and Reconnaissance (ISR)
- Weather, Terrain, and Environmental Monitoring (WTEM)
- Position, Navigation, and Timing
- Missile Warning
- Space Control

The overall assessment for the Materiel portion of DTLOMS is Amber. The overriding criterion for the Amber assessment is the projected ability to maintain overmatch and to execute the modernization strategy. Because of resource constraints, materiel limitations are more significant than those in the DTLOS domains. A purposeful and well-executed plan is required to attain a Green rating.

Communications Assessment

The key enabler for Information Dominance is assured communications. The Army's single, largest utilization of space assets is the information flow through satellites for voice, data, and imagery. These products enable the Army to "see" the battlefield and to disseminate accurate and timely information. That capability is rated Amber in the near term due to decay of existing constellations and gaps in their replacements, lack of trained personnel, and shortfalls in equipment.

Several initiatives are underway to bring these capabilities to Green. These initiatives include: fully fielding Defense Satellite Communications System (DSCS) Gapfiller, Milstar, and Global Broadcast Service (GBS) Phase II constellations in the near term and Advanced Extremely High Frequency (EHF) and Advanced Wideband constellations in the mid term. Higher capacity terminals including the SHF Tri-Band Advanced Range Extension Tactical Terminal (STAR-T), the Secure Mobile Anti-Jam Reliable Tactical Terminal (SMART-T) Block II, and Joint Tactical Radio System (JTRS) technology will increase the capability of the ground segments. Information Dissemination Management (IDM) initiatives and increased use of commercial satellite systems will also help relieve information congestion. However, assessments based on the Integrated Communications Database (ICDB) and Emerging Requirements Database (ERDB) indicate that information requirements may grow beyond the combined ability of military owned and commercial systems.

Assured access to Satellite Communications (SATCOM) is the most important requirement for the warfighter. This means that the necessary amounts of DoD-owned and commercial SATCOM are available and accessible to the warfighter when and where needed. The SATCOM resources, which include satellites as well as terminals, should have the ability to be configured or reconfigured by the operational commander based upon a changing mission and should be accessible to him for the duration of that mission.

The three most critical warfighting requirements for the Army in the objective time frame are the ability to communicate while on the move, the use of high capacity communications using DoD and commercial systems, and protected, survivable communications. Furthermore, future SATCOM systems supporting the warfighter must come on line without any

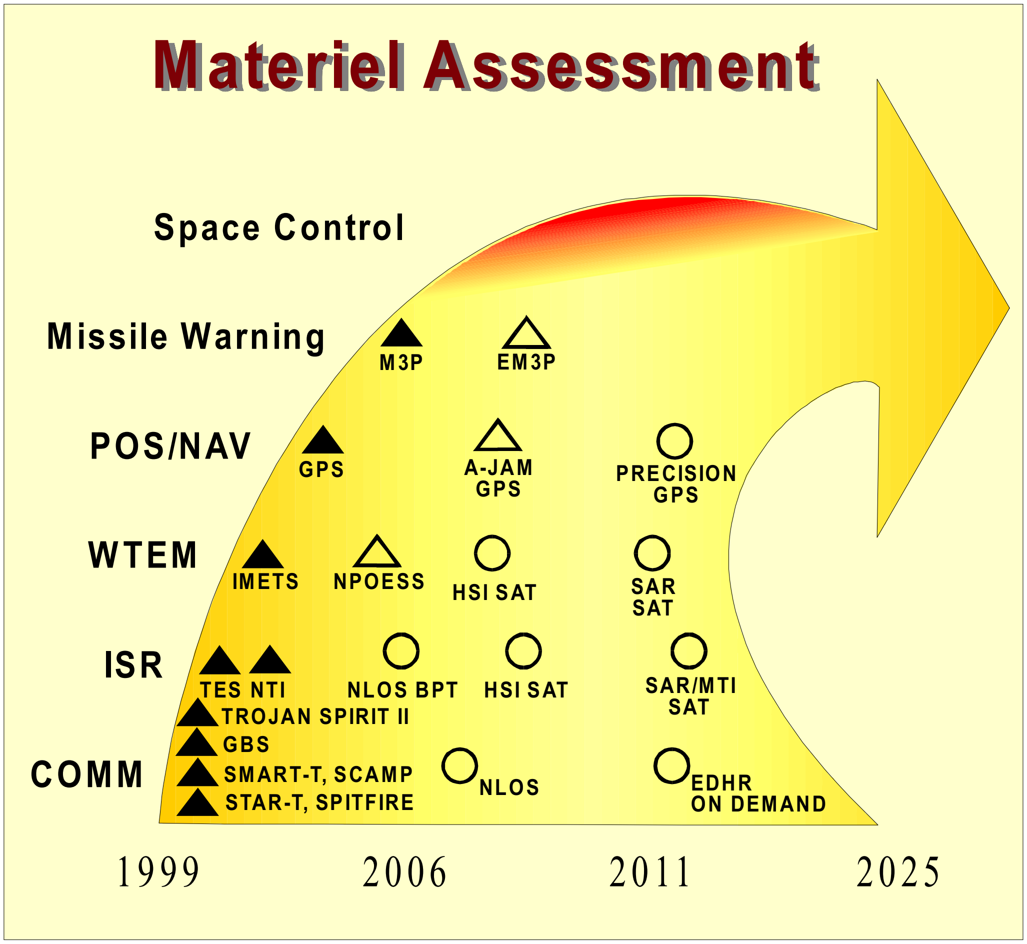


Figure 7-3: Materiel Assessment of Army Space Capabilities

degradation or gap in the quantity or quality of communications. The Army's capability for assured communication is being addressed. However, it will require increased, sustained emphasis and will remain Amber for the foreseeable future.

Intelligence, Surveillance, and Reconnaissance (ISR) Assessment

Several of the seventeen approved space FOC's impact ISR. Any operation—from alert through recovery—depends upon timely, accurate and reliable intelligence. The capability to monitor, detect and alert ground forces to active and passive targets is limited primarily by the communications shortfalls previously described. The use of national assets (TENCAP) potentially makes more relevant information available and promises increased capability in the near-term following TES deployment into the theater. In the mid-term, initiatives such as BOA and Overhead Passive Sensor Technology for Battlefield Awareness will enable detection and location of targets. Hyperspectral imagery processing and Lasercom will permit greater refinement of targeting and dissemination of information, as well.

A significant emphasis is required in Battle Damage Assessment. Targeting is of little value if the results are unknown. Mid- and far-term attention must be emphasized. ISR is assessed as Amber—progress is indicated, but limitations persist.

Weather Terrain and Environmental Monitoring (WTEM) Assessment

Information dominance, situational awareness, and intelligence preparation of the battlespace all require accurate WTEM. Weather, terrain, and environment data are vital to conducting combat operations. Other planning factors, e.g., sustainment activities and on-time logistics, are WTEM-dependent as well. Weather capability is limited in the near-term with DMSP and POES, but this should improve significantly in the mid-term with IMETS and NPOESS fieldings.

The interface with terrain data is provided by DTSS, which is expanding its capability and access. Existing limitations in terrain data are being met incrementally. Short-term initiatives are capable of providing immediate WTEM down to the tactical level for short-term actions. Eagle Vision II and Project Stalker (both discussed in Chapter 6) are good examples. The near-term assessment for WTEM is Amber, but planned and programmed improvement should enable a Green rating for the mid- and far-term.

Position, Navigation and Timing Assessment

The Global Positioning System (GPS) has had a revolutionary effect upon Army systems, planning, and operations. Blue Force Tracking, targeting, and weapon delivery systems made possible by GPS are contributing to precision engagement, dominant maneuver, and sustainment activities.

Limitations on equipment density exist in the near-term. In the mid- and far-terms however, follow-on satellites will be deployed as required. Position, navigation and timing in the near-term are vulnerable to jamming. There are no good fixes in the near- and mid-terms. User equipment improvements will be phased in over the near- and mid-terms, but those improvements alone will not do the trick. Only when new user equipment and satellite improvements are both available will position and navigation be "more assured." Satellite improvements will not be available until 2012. Even then, the Army will have legacy user equipment on the battlefield for years to come. The satellites will be more reliable, more accurate, and less susceptible to jamming or spoofing. In the near-term, position, navigation and timing is assessed as Amber; in the mid- to far-terms position and navigation is assessed as Amber/Green.

Missile Warning Assessment

The Defense Support Program currently monitors missile launches worldwide. Production and fielding of JTAGS has refined this capability and made it relevant to the theater. Further refinement will result as DSP satellites are replaced with the Space Based Infrared System (SBIRS) and as JTAGS concurrently transitions to the Multi-Mission Mobile Processor (M3P). The assessment of Ballistic missile warning capability is Green. Cruise missile defense is more problematic, and while space assets and products will assuredly comprise a part of the CMD warning solution set, an integrated approach to CMD still lacks definition.

Space Control Assessment

Space control incorporates passive, offensive, and defensive measures to assure control and use of space. National policy at present does not support operational offensive measures in space. However, two technology development initiatives are underway to pursue such a capability: the Army KE ASAT is a ground based ATD; the Air Force effort is a technology development program for a ground-based laser ASAT.

Defensive measures such as satellite interoperability, cross-platform warning, and evasion are not within the province of the Army. It is not apparent that the Army is influencing the other Services or the DoD to actively pursue incorporation of defensive tactics. Passive measures available would include denial/ termination of services or encryption/ decryption of data. At present, all or none of the existing assets or services is available to specified users.

The overall space control assessment is Red. Currently, the Army has a Space Control Integrated Concept Team that looks to address some of the key components of space control (surveillance, prevention, protection, and negation) each at varying degrees.

Army Operations

Space mission area FOCs support Army operations, initiatives, and goals derived from JV 2010 operational concepts, as discussed in chapters 1 and 3. Table 7-2 matches Army operational goals with the supporting FOCs. There is not a one-to-one matching function between this table and the ratings presented throughout the remainder of this chapter. Rather, the table presents a snapshot of the projected adequacy of proposed materiel solutions to enable key operational parameters. The complete listing of materiel solutions is contained in Annex C.

Information Requirements

The ability of US Forces to have access to and to use information freely, while denying or degrading the enemy's use of information will require a joint, integrated effort. Space-based systems will be critical to the uninterrupted flow of information. Satellites will provide or enable surveillance capabilities, real time intelligence, global secure communications, position and navigation data, and weather, terrain, and environmental data necessary to ensure situational awareness and a common picture of the battlespace. Providing such information to the force—in the quality required—will necessitate the positioning of an extensive integrated architecture. Portions of this architecture are in place; more are programmed. However, the requisite quantities and overall capabilities fall short of the requirement, limiting mission accomplishment. The overall assessment is Amber.

Total situational awareness is also required to seize the initiative and lay the groundwork for decisive operations. Key space-based systems can provide commanders with the ability to "see" throughout the battlespace, communicate horizontally, and fully prosecute the battle. Higher asset density and greater capability than is being resourced will be required to completely shape the battlespace prior to commencement of decisive operations. Our ability to shape the battlespace is rated Amber for the entire rated period.

Decisive operations require synchronization of all forces, all fires, all maneuver, and all support, and may commence when the force commander determines he can deliver a paralyzing blow or series of blows to the enemy force. Assured communications, total situational awareness, and horizontal and vertical integration of effort will tax all capabilities called for by the relevant space FOCs. Until such time as existing and planned assets and technologies match those required capabilities, the ability to fully and decisively prosecute the synchronized operations is limited, and is rated as Amber.

Force Protection

Attaining information superiority will better enable the Army to protect the force. Space-based systems make possible the IPB necessary for development and maintenance of force protection activities. Limitations in asset density, not in performance or capability, drive the overall ability to ensure force protection for the foreseeable future, resulting in a rating of Amber.

Sustainment and Reach Back

Sustainment and reach back operations are completely dependent upon the uninterrupted flow of information. Increasingly, that information is secured from space-based systems. The speed and agility of our force, and the knowledge to fully employ those advantages, require focused logistics, precise asset visibility, and rapid assessment of needs. Information dominance must be assured. As with the other initiatives, requirements far outstrip programmed abilities to accurately and reliably conduct force sustainment and reach back operations throughout the rated time periods. The result is an overall assessment of Amber.

Strategic Responsiveness

The movement into the theater of operations by ground forces and the ability to move from mission to mission with little reduction of momentum requires precise information, often only available from space-based or other remote means. After arrival in theater, demands for information will increase, as situational awareness, the status of and deployed forces, IPB, and other requirements come into play. The capabilities of existing and planned systems are limited, but are sufficient to meet the demands imposed upon them. Consequently, our capability to project the force is rated Amber.

FOCs	Information Dominance	Survivability	Sustainability	Deployability	Strategic Responsiveness	Agility, Versatility, Lethality
	Objective Force Parameters					
SP 97-001. Space Sensors Linked with Terrestrial Systems	A	A	A	A	A	A
SP 97-002. Passive and Active Target Detection and Processing	A	A		A	A	A
SP 97-004. Support Battle Damage Assessment					R	R
SP 97-005. Space Simulation and Modeling Tools.	A	A	A	A	A	A
SP 97-007. Interoperability	A	A	A	A	A	A
SP 97-008. Responsive and Reliable Network Architecture	R	R	R	R	R	R
SP 97-009. Real Time Prioritized Information Dissemination	A	A	A	A	A	A
SP 97-011. Standardization of Battlespace Data	A					
SP 97-012. Survivable Systems with Low Probability of Intercept					A	A
SP 97-014. Collection and Dissemination of Mapping, Charting, and Geodesy Data		A		A	A	A
SP 97-015. Collection and Dissemination of Targeting Data (All Sources)				A	A	A
SP 97-016. Automatic/Aided Target Recognition		A		A	A	A
SP 97-017. Continuous and Global Satellite Coverage	A	A	A	A	A	A
SP 97-018. Army Space Qualified Personnel	G	G	G	G	G	G
SP 97-019. Army Support for Modular Satellite Construction	A	A	A	A	A	A
SP 97-020. Theater Missile Defense	A	A	A	A	A	A
SP 97-021. Offensive Space Control	R				R	R

Table 7-2: FOC Support to Objective Force Parameters

Summary

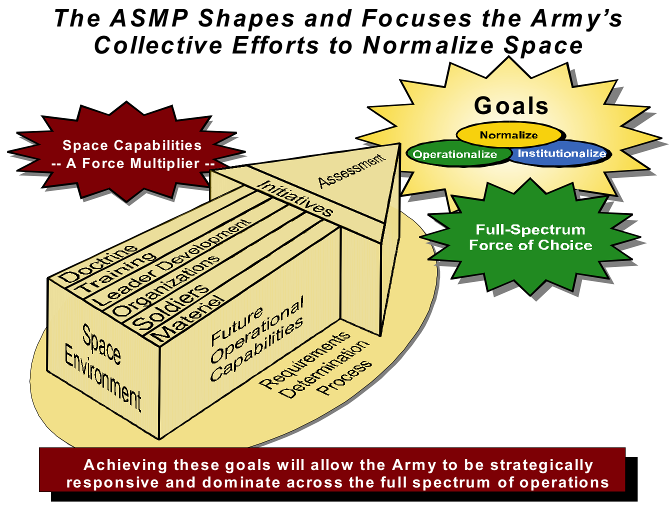
Assessing the Army's existing and planned space capabilities permits a realistic focus on resource investment decisions. In the non-materiel (DTLOS) domain it is apparent that the organizational, doctrinal, and leaders road map (Figure 7-1) are in place to off-set existing shortfalls. Internal and external commitments of resources (people, time, and funds) will be required to complete the tasks necessary to normalize and institutionalize space. For example, functional area transition training and advanced individual training curricula may require investment in additional resources.

Solutions to warfighter space materiel activities are more problematic. To optimize future investments, the Army must derive and quantify specific warfighter requirements. This process will require new initiatives, reprogramming of existing or planned programs, and cancellation of others. The materiel domain in space does not have the benefit of a long standing tradition, a branch of service, or a Directorate for Combat Development (DCD). The challenge here requires near-term emphasis for long term value.

The limitations found result primarily from low asset density, which can be resolved throughout the rated time periods by judicious prioritization or re-prioritization of resources and programs. In some areas, the problems stem from non-specific and unimaginative FOCs. The Army must establish space requirements in which it has traditionally not participated. Examples of this new focus are Offensive Space Control, Modular Satellite Construction, and Force Application. The success in ultimately achieving the Army's goals is tied to influencing the design and resourcing the warfighter materiel solutions where required.

Chapter 8: Conclusions and Challenges

- **Azimuth**
- **Goals and End State**
- **Challenges**
- **Next ASMP**
- **Space ICT**
- **Summary**



Azimuth

The Army's course into space can be charted in the diagram above, introduced earlier in Chapter 1. Based upon the visions of the CJCS, CSA, and USCINCSPACE, senior leaders throughout the Army must encourage and elicit space integration in all aspects of Army operations. Focused on FOCs, the TRADOC processes must be followed in order to achieve the desired goals of operationalizing, institutionalizing, and normalizing space leading to the end state of dominance across the full spectrum of operations.

As with every revolution in military affairs, many obstacles must be overcome. Institutional barriers such as parochialism, turf battles, and inflexible, "in the box" thinking are just a few examples. Most of these impediments will be overcome as we more clearly understand and then apply space capabilities into our work.

> ***"We have some challenges ahead: balancing progressive innovation with ongoing support to today's missions; orchestrating broadbased multi-organization efforts; developing technically and professionally; inter-operating in commercial and international domains; and acquiring and managing resources effectively. We have a lot to do, but it is well within our talents. Our success will make a difference to the Nation—now, tomorrow, and into the future."***
>
> **USASMDC Vision October 1, 1997**

Goals and End State

The ASMP reviewed the senior leader visions (Chapter 1), the space environment (Chapter 2), the TRADOC requirements processes (Chapter 3), and DTLOMS actions (Chapters 4, 5, and 6) then developed a current assessment by space FOC (Chapter 7 and Annex C). That assessment, coupled with the plan's primary goal to shape and focus Army leadership and staff at all levels, will chart a deliberate course for the Army to *normalize* space technologies and capabilities and *achieve full spectrum dominance.*

This detailed review of the Army's involvement in space activities concludes that "space" in the Army remains focused on vertical developments and is not benefiting from horizontal integration. In addition, although elements of space-related missions exist in most organizations and agencies, to a large degree they are specialized, of lesser importance, and often secondary if not tertiary duties. In light of the Army's recognized importance and reliance on space-based capabilities, this plan supports the migration from a compartmented space capability to one that is fully *institutionalized and operationalized*.

The Army's end state is dominance across the full spectrum of operations—the emerging synergy of space superiority equal to land, sea, and air. To achieve this end, it is imperative that the Army ingrains space into its way of life—**normalize space**.

Figure 8-1: Normalizing Space Tasks

Institutionalize Space

Advance Space Education and Literacy

Continue to Refine AWC & CGSC Electives

Implement Functional Area 40

Improve ASI 3Y Program

Consider Space Embedded in all FOCs

Analyze and Refine 17 "Space" FOCs

Ensure Doctrinal Integration

Use the Center for Lessons Learned

Critical Actions are highlighted in Red

Figure 8-2: Institutionalizing Space Tasks

Operationalize Space

Develop Space-Capabilities Modeling & Simulations

Include Space in Exercises & Wargames

Approve a Space Section for Corps/Div Staff

Use ASSC & ARSSTs

Execute Materiel Modernization Strategy

Ensure Army Requirements are Included in Design of:

- Force Enhancement Systems
- Space Control Systems
- Force Application Systems

Support USCINCSPACE Long Range Plan

Critical Actions are highlighted in Red

Figure 8-3: Operationalizing Space Tasks

To perform the tasks in the three previous goals charts, several challenges have been identified which must be met to be successful. In addition to the implementation of this ASMP, before the *normalization* of space can be realized, the Army must focus and shape its efforts to embed and use space in day-to-day operations and to fully integrate space into its institutions. These efforts will greatly enhance normalizing space by achieving the deliberate and conscious inclusion of space-based capabilities into the Army's entire planning, training, and operating spectrum.

Also, as the familiarity of space-based capabilities begins to influence tactical thinkers, the Army needs to re-think its doctrinal approaches to war fighting to capture space-supported concepts and procedures.

The next ASMP must include how the Army will take advantage of other services and commercial efforts in space. The next plan must be linked to the USSPACECOM operational concept of Global Partnerships.

The war colleges and staff colleges are prime examples of opportunities for the Army to *institutionalize* the appreciation of space capabilities throughout the officer corps. Additional and challenging space electives, capturing leading edge technologies and their applications to the warfighter, must be developed and offered. The opportunity to improve space literacy within the Army should occur at every level of the military education system—from basic training initiation tasks to War College research papers.

The FA 40 initiative will not only enhance the resident technical caliber of space support personnel, but it will also assign those individuals to staff positions in operational units that will influence operations of space capabilities. The Army must carefully implement FA 40 and develop effective special space staff sections. The FA 40 officers must not only be space literate, but space savvy. They must spearhead the effort to integrate space into corps and division staffs. The FA 40 specialty must clearly chart a career path that includes duty assignments to authorized space staff positions not unlike NBC, engineer support, and TALOs. At the same time, the process of awarding a 3Y additional skill identifier should be examined to determine applicability to NCO education levels.

The space requirements process, which follows TRADOC Pamphlet 71-9, needs to be integrated and more robust. All of the FOCs that touch space need to be included in follow-on assessments. In the future, all proponents and integrating centers need to be involved in the space requirements process as well as the specific space proponents.

Since space capabilities affect all elements of the Army, there must be a conscious effort to ensure that space doctrine is integrated into all the functional doctrine publications. An important institution to demonstrate how space benefits Army operations is the Center for Army Lessons Learned. The Army needs to capture the exercise results of units that are successfully employing space innovations and operational concepts.

To completely *operationalize* space, Army leaders must continue to embed space capabilities and limitations in all they do. Planning, operations, and exercises must fully address space. It is essential that the Army invest in appropriate models and simulations of tactical space capabilities. The Army must thoroughly understand and effectively apply space in education, training, exercises, wargames and operations.

The concept of a special staff section for space at corps, divisions, and separate brigades has the potential to revolutionize the ways in which space is integrated into planning, readiness and operations. ARSSTs and the ASSC will continue to support land commanders during the near term. However, as the Army operationalizes space throughout the force, organic space officers may inherit these responsibilities over time.

The Army's near-term space modernization focuses on procuring the proper mix of ground segment terminals. The Army must execute the modernization strategy defined in Annex P (Space) of the Army Modernization Plan. For the future, the emphasis lies with a concerted effort to define the Warfighter requirements that would influence the design of:

- Force enhancement systems
- Space control systems
- Force application systems

It is in the arena of Joint requirements definition that the Army's future space support will be secured. In that light, the role USARSPACE plays as the Army's space component is key: not only in assistance with warfighter requirements definition, but also involvement in the USSPACECOM Space Planning and Requirements System (SPRS).

To achieve information dominance, conduct decisive operations, and to realize the CJCS, CSA, and USCINCSPACE visions, the three goals to operationalize, institutionalize, and normalize space must be vigorously pursued across the force.

Challenges

In addition to accomplishing the tasks identified in the last section, the Army faces other challenges to reach its goals and achieve full spectrum dominance.

A major challenge confronting subsequent ASMPs is the incorporation and delineation of a detailed space programming and budgeting timeline. This integration into the PPBS process is critical to ensure that space capabilities are fielded and supporting the force. This PPBS integration is not a trivial process and will be evolutionary in nature, requiring several iterations before it is comprehensive and coherent. This integration will cover the breadth of the PPBS from planning to execution.

Part of this PPBS process impacts space technologies. These technologies and their applications can be revolutionary in nature and their applicability and introduction into the force must be carefully managed and controlled. From a technological perspective, space initiatives can cover the whole gamut of concepts, experiments, and demonstrations. Modeling and simulation advancements must be incorporated into these initiatives. In many cases, some of these initiatives have some duplication and/or overlap. In this era of constrained funding, it is

Figure 8-4: Challenges

imperative that a cohesive and integrated approach be taken in maximizing the Army's return on investment for space. In the future, it may be appropriate to designate an Army element or agency to be the facilitator and/or integrator to include visibility of the budget for those initiatives in which the Army is involved. This should minimize duplication and maximize the benefit to the Army.

As the 17 space FOCs are reviewed, refined, and revised, another challenge for the Army will be to determine the linkages with the evolving Desired Operational Capabilities (DOCs) which are being developed by the Joint Staff in coordination with the CINCs. The CINCs' Integrated Priority Lists (IPLs) should also reflect many of the DOCs. Thus, a substantial number of "space" DOC elements may be traceable to USSPACECOM's Integrated Priority List (IPL). The overall result will be a traceability and linkage that will reinforce and solidify how vital space capabilities are to the warfighter. The Army needs to take a broader view of requirements for space capabilities by not only addressing force enhancement requirements, but also requirements within the space control and force application mission areas which will benefit the land Warfighter.

The role of Information Operations (IO) must be considered and examined, and integrated into the next ASMP. IO and space are clearly linked, and the challenge that is confronting the community as a whole is clearly defining their relationships and then developing and implementing the correct processes and courses of action. Further complicating this situation is the emerging IO role of USSPACECOM. From an ASMP perspective, the more clearly understood the roles of space and IO are, the better the LCC will be able to achieve full spectrum dominance.

Next Army Space Master Plan

The next Army Space Master Plan will expand and more precisely define the broad direction stated in this Master Plan. The next ASMP must provide more specific milestones and more detailed timelines, coupled with the identification of organizations and/or agencies that have proponency for each area. These proponents will be responsible for the information contained in the next plan.

The challenge of linking the Army's requirements to the US Space Command Long Range Plan and Integrated Priority List must be met, and the results of this synchronization and mutual support must be included in the next ASMP.

A separate chapter on the Planning, Programming, and Budgeting System is envisioned for the next plan in order to prioritize and quantify actual resources in one place.

A chapter should be devoted to describing and explaining how the Army will improve the integration of space into joint and land component commander operations. USARSPACE appears to be the natural proponent to lead this discussion of linkage and leverage of the military space community into LCC, corps, division, and brigade operations, training, and readiness.

Emphasis must continue from the perspective of the Joint community, including DoD, USCINCSPACE, and the National Reconnaissance Office. As this "jointness" is examined, opportunities to leverage the efforts of other agencies will be identified and pursued.

Due to the fact that space impacts so many elements of the Army, succeeding ASMPs will require significant involvement and commitment by more of the Army community. The coordination and efforts in generating the next ASMP must be expanded to include all materiel and combat developers, as well as warfighting organizations and units.

The road ahead involves the continued definition and evolution of information operations, and the identification of its inter-relationships with space.

Modeling and simulation must receive more research and analysis, and a specific strategy for Army space will be delineated in the next plan.

The Army believes that this plan is a move in the right direction. Unlike functional area master plans, the ASMP impacts the Army across all the traditional combat, combat support, and combat service support areas. Gaining understanding and support for the plan's execution will influence the successful inclusion of space capabilities into routine Army operations. This plan has set the stage, but the importance of succeeding ASMPs cannot be overstated.

Space Integrated Concept Team (ICT)

In order to generate and produce the next ASMP and move the Army forward along the course charted in the current ASMP, the Army must adhere to a very structured framework and process in order to ensure that the proper coordination and integration occurs. One element in this process, particularly with regard to DTLOMS solutions, will be the establishment of a TRADOC-sponsored Tier 1 Space Integrated Concept Team (ICT). Working groups within the Space ICT will provide input during the development of the next ASMP. This Space ICT will integrate military, national, civil, and commercial space operations and capabilities throughout the Army. The Space (ICT) has been chartered to:

- Develop and prioritize space DTLOMS initiatives and solutions, and identify policy initiatives.
- Manage and facilitate the integration of space into near, mid, and far term Army force structures (e.g., Army XXI and AAN).
- Build and broaden the consensus for space DTLOMS issues across the Army.

In general, participants will include SMDC headquarters and subordinate commands, TRADOC headquarters and schools, and the DA Staff. The Space ICT will report directly to the CG, SMDC. Key objectives of the Space ICT are to:

- Prioritize and synchronize ongoing and future space DTLOMS initiatives in support of Army XXI with an emphasis on the development of a revised space warfighting concept of operation with applicable space FOCs, and a revised space doctrine.
- Determine near, mid, and far term DTLOMS issues, prepare milestones, and intensely manage to ensure successful and timely completion.
- Operationalize and integrate space DTLOMS initiatives and solutions into Army and Joint warfighting training and operations.
- Identify space issues to be presented in other space forums (e.g., Army Space Executive Working Group, Space General Officer Steering Council, and DoD space working groups).

Inputs from this ICT forum may assist to define the structure, determine the timeline and contents of subsequent ASMPs, assign responsibilities, activate working groups, and resolve potential conflicts. Potential ICT contributions related to the ASMP are shown below:

- Fix responsibility - who, what, when, where, why.
- Define the structure for the next ASMP.
- Incorporate the USSPACECOM Mission Area Working Groups (MAWGs) into the process.
- Fully analyze battlefield operating systems as affected by space capabilities.
- Establish a strategy for implementation and execution accountability.

The Space ICT efforts will help ensure that the next Army Space Master Plan provides the Army a more detailed strategy—based upon focused efforts of the ICT working groups—and result in a more precise roadmap with milestones to operationalize, institutionalize, and normalize space.

Summary

This plan charts a course to achieve desired Army Vision full spectrum capabilities, CONOPS, and organizations necessary to promote the Army's strategic responsiveness to protect US national interests, deter war, and if necessary fight and win our nation's battles. Normalization of space will enable the Army to achieve dominance across the full spectrum of operations. The combined effects of the current strategic pause, the evolving space and information age, and the likelihood of a Revolution in Military Affairs (RMA) enabled by space capabilities indicate that the time is right to have an integrated master plan for space.

The widening role that space plays in tactical operations demands a coherent, focused, and workable plan to maximize the Warfighter's advantage. This ASMP is the Army's effort to state where space plays in the battlefield equation. This is a dynamic plan that will benefit from informed discussion and innovative dialogue throughout the spectrum of the Army Space Community (Annex F).

One of the next steps is to develop greater control over the near term (covering the Future Years Defense Plan [FYDP]). This process will include detailed information on timelines for documenting requirements (e.g., start dates of Mission Need Statements and Capstone Requirements Documents), acquisition milestones, and related initiatives on policies, CONOPS, organizations, and partnerships. Through annual updates, the ASMP will present a 20 to 25-year roadmap to the Army Vision as well as a more detailed near-term roadmap. Once developed and implemented, the Space Integrated Concept Team will guide the evolution of future Army Space Master Plans.

The desired impact of this ASMP is to focus efforts that propel the Army further into the 21st Century. To achieve this evolution, the Army must still accomplish many things. As with all plans, the key is how to implement it. As this phase progresses, new programs, policies, and doctrinal issues will emerge and cause the modification of the next edition of the ASMP.

By following the azimuth in the ASMP, all leaders (commanders, commandants, and directors) have the responsibility to integrate space in the spirit of this plan in order to enable the Army to reach the goals of JV 2010, the Army Vision, and the USCINCSPACE Vision for 2020 and to realize the goals in this ASMP.

Annex A: Acronyms and Abbreviations

3D .... Three Dimensional
3Y .... Additional Skill Indicator for Space Activities
AACB .... Aeronautics and Astronautics Coordination Board
AAN .... Army After Next
AAMDC .... Army Air and Missile Defense Command
ABCS .... Army Battle Command System
ABL .... Airborne Laser
ABM .... Antiballistic Missile
ACS .... Advanced Communications Systems
ACTD .... Advanced Concept Technology Demonstration
ACT II .... Advanced Concepts and Technology Program II
ADIM .... Air Defense and Intelligence Module
AEOWS .... Advanced Electro-Optical Warning Sensor
AEPDS .... Advanced Electronic Processing and Dissemination System AFFORAir Force Forces
AFSATCOM .... Air Force Satellite Communications System
AFSCN .... Air Force Satellite Control Network
AFSPACE .... Air Force Component to USSPACECOM (14th Air Force)
AFSPC .... Air Force Space Command
AJ/AS .... Anti-Jam/Anti-Spoof
ALCOR .... ARPA Lincoln C-Band Observation Radar
ALRPG .... Army Long Range Planning Guidance
ALERT .... Attack, Locate and Early Report to Theater
ALTAIR .... ARPA Long-range Tracking and Identification Radar
AMBL .... Air Maneuver Battle Lab
AMDPCS .... Air and Missile Defense Planning and Control System
AOI .... Area of Interest
AOR .... Area of Responsibility
ARC .... Advanced Research Center
ARCTIC .... Advanced Research Center Telecommunications Interface Console
ARFOR .... Army Forces
ARPA .... Advanced Research Projects Agency (Now DARPA)
ARSPACE .... Army Space Command
ARSST .... Army Space Support Teams
ARTS .... Automated Remote Tracking System
ASARS .... Advanced Synthetic Aperture Radar System
ASAS .... All Source Analysis System
ASAT .... Anti-Satellite
ASCC .... Alternate Space Control Center
ASD/C3I .... Assistant Secretary of Defense/Command, Control, Communications and Intelligence
ASEDP .... Army Space Exploitation Demonstration Program

ASEWG ....Army Space Executive Working Group
ASI ....Additional Skill Indicator
ASMP...Army Space Master Plan
ASP ....Army Space Policy
ASPO ....Army Space Program Office
ASSC ....Army Space Support Cell
AST ....Airborne Surveillance Testbed
ATD ....Advanced Technology Demonstration
ATM...Asynchronous Transfer Mode
ATMDE ....Army Theater Missile Defense Element
ASTRO ....Automated Scheduling Tools for Range Operations
ATR ....Automated/Aided Target Recognition
AV 2010..Army Vision 2010
AUS ....Advanced Upper Stages
AWACS ....Airborne Warning and Control System
AWE ....Advanced Warfighting Experiment
AWS...Advanced Wideband System
BAA ....Broad Agency Announcement
BCBL ....Battle Command Battle Lab
BCR2 ....Battle Command Reengineering 2
BCV ....Battle Command Vehicle
BDA ....Battle Damage Assessment
BESim ....Brilliant Eyes Simulation
BFT ....Blue Force Tracking
BLE ....Battle Laboratory Experiment
BLOS ....Beyond Line of Sight
BM ....Battle Manager
BMC...Ballistic Missile Center/Battle Management Cell
BMC3...Ballistic Missile Command, Control and Communications
BMD ....Ballistic Missile Defense
BMDO ....Ballistic Missile Defense Office
BOA ....Battlefield Ordnance Awareness
BV ....Battlefield Visualization
C2 ....Command and Control
C4I ....Command, Control, Communications, Computers, and Intelligence
C4ISR...Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance
CA ....Combat Arms
CALL ....Center for Army Lessons Learned
CASCOM.....................................Combined Arms Support Command
CAV ....Common Aero Vehicle
CBM...Conventional Ballistic Missile
CCD ....Coherent Change Detection
CC&D ....Camouflage, Concealment and Deception

CCIS ....Civil/Commercial Imagery Systems
CEASE ....Compact Environmental Anomaly Sensor
CECOM ....Communications and Electronic Command
CENTCOM ....Central Command
CEP ....Concept Experimentation Program
CFD..Computational Fluid Dynamics
CFJO ....Concept for Future Joint Operations
CG ....Commanding General
CGS..Common Ground Station
CIA...Central Intelligence Agency
CIGSS ....Common Imagery Ground/Surface System
CINC ....Commander in Chief
CIP ....Common Imagery Processor
CJCS ....Chairman, Joint Chiefs of Staff
CJTF...Combined Joint Task Force
cm...centimeter
CMO ....Commercial Satellite Communication Initiative Management Office
CNN ....Cable News Network
CNO ....Chief of Naval Operations
CIGSS ....Common Imagery/Surface System
CFJO ....Concept of Future Joint Operations
COA ....Course of Action
COIL ....Chemical Oxygen-Iodine Lasers
COMAFSPACE ....Commander, Air Force Space Command (14th AF)
COMARSPACE ....Commander Army Space Command
COMM ....Communications
COMNAVSPACECOM ....Commander Naval Space Command
CONOPS......................................Concept of Operations
COMSEC ....Communications Security
CONR ....CONUS NORAD Region
CONUS..Continental United States
COOP...Continuity of Operations Plan
COP..Common Operating Picture
CoS...Control of Space/ Chief of Staff
COTS ....Commercial-Off-The-Shelf
CPT ....Command Post Terminal
CSLA ....Commercial Space Launch Act
CS...Combat Support
CSA ....Chief of Staff, United States Army
CSCI...Commercial Satellite Communications Initiative
CSP ....Communications System Processor
CSS ....Combat Service Support
CUGR ....Cargo Utility GPS Receiver
CWT...Combat Weather Team
DA..Department of the Army

DAMA ....Demand Assigned Multiple Access
DARPA ....Defense Advanced Research Projects Agency
DASD C3ISR..............................Deputy Assistant Secretary of Defense for Command, Control, Communications, Intelligence, Surveillance and Reconnaissance and Space Systems
DAWE ....Division Advanced Warfighter Experiment
DBA ....Dominant Battlefield Awareness
DBLS ....Distribution Based Logistics System
DCI...Director Central Intelligence
DCINC ....Deputy Commander in Chief
D & D...Denial & Deception
DDS ....Defense Dissemination System
DDCI..Deputy Director of Central Intelligence
DDL ....Direct Downlink
DE ....Directed Energy
DGPS ....Differential GPS
DIICOE ....Defense Information Infrastructure Common Operating Environment
DISA ....Defense Information Systems Agency
DISC4 ....Director of Information Systems for Command, Control, Communications, and Computers
DISN ....Defense Information Systems Network
DITP...Discriminatory Interceptor Technology Program
DMS ....Defense Message System
DMSP...Defense Meteorological Satellite Program
DNRO ....Director of the National Reconnaissance Office
DOC ....Department of Commerce
DOCC ....Deep Operations Coordination Cell
DoD..Department of Defense
DoDOSA....................................Department of Defense Office of the Space Architect
DOT ....Department of Transportation
DRB ....Defense Resource Board
DREN...Defense Research and Engineering Network
DRI...Defense Reform Initiative
DSCS ....Defense Satellite Communications System
DSCSOC....................................DSCS Operations Center
DSNET.......................................Defense Security Network (?)
DSP ....Defense Support Program
DTD ....Digital Terrain Data
DTES ....Division Tactical Exploitation System
DTED...Digital Terrain Elevation Data
DTLOMS ....Doctrine, Training, Leader Development, Organizations, Materiel and Soldiers
DTLOS.......................................Non-Materiel DTLOMS
DTO ....Defense Technology Objective

DTS ....Diplomatic Telecommunication Service
DTSS..Digital Topographical Support System
DTSS-D ....Digital Topographical Support System-Division
DTSS-H ....Digital Topographical Support System-Heavy
DTSS-L.......................................Digital Topographical Support System-Light
DUSD(Space) ....Deputy Under Secretary of Defense for Space
DWSW..Deployable Weather Satellite Workstation
EAC ....Echelons Above Corps
EADTB ....Extended Air Defense Testbed
ECB..Echelons Corps and Below
EELV ....Evolved Expendable Launch Vehicle
EGI...Embedded GPS Inertial
EHDR...Extreme High Data Rate
ELINT ....Electronic Intelligence
ELV..Expendable Launch Vehicle
EMP ....Electro Magnetic Pulse
EMUT ....Enhanced Manpack UHF Terminal
E/O ....Electro-Optical
EOSAT.......................................Earth Observation Satellite
EPLGR.......................................Enhanced PLGR
EPLRS ....Enhanced Position, Location, Reporting System
ERM...Earth Resource Monitoring
ETRAC ....Enhanced Tactical Radar Correlator
ETUT ....Enhanced Tactical Users' Terminal
EUCOM ....European Command
EW ....Electronic Warfare
EWE...Early Warning Experiment
EWR...Early Warning Radar
FA 40 ....Functional Area 40 (Space Operations Officer)
FAA ....Federal Aviation Administration
FAR..Federal Acquisition Regulation
FAST..Forward Area Support Terminal
FBXB ....Forward-Based X-Band
FCC..Federal Communications Commission
FDIC ....Force Development Integration Center
FDL..FAAD Data Link
FDO ....Flexible Deterrent Options
FFI..Full Force Integration
FLTSAT.....................................Fleet Satellite Communication System
FMS ....Foreign Military Sales
FOC..Future Operational Capability
FY ....Fiscal Year
FYDP ....Future Years Defense Program
G-B...Grenadier-Beyond Line of Sight Ranging and Tracking System
GBE ....Ground-Based EMP

GBI..Ground-Based Interceptor
GBL ....Ground-Based Laser
GBS...Global Broadcast Service
GCCS ....Global Command and Control System
GCN ....Ground Communications Network
GCSS ....Global Command Support System
GDIN ....Global Defense Information Network
GE ....Global Engagement
GEO ....Geosychronous Earth Orbit/Geostationary Earth Orbit
GEODSS ....Ground-Based Electro-Optical Deep Space Surveillance
GIS ....Geographic Information System
GLOBALSTAR ....Commercial Name of System
GMF ....Ground Mobile Forces
GMPCS ....Global Mobile Personal Communications Satellite
GOES ....Geostationary Operational Environmental Satellite
GOSC ....General Officer Steering Committee
GP ....Global Partnerships
GPS ....Global Positioning System
GPX ....Global Positioning System Execution Group
GRAM ....GPS Receiver Application Module
Grenadier-BRAT ....Grenadier-Beyond Line of Sight Range and Tracking System
GRT ....Ground Receive Terminal
GSD ....Graphical Situation Display
G STAR ....GLOBALSTAR
GUI ....Graphical User Interface
HA-UAV....................................High Altitude Unmanned Aerial Vehicle
HDLC...High Level Data Link Control
HDR ....High Data Rate
HEMP ....High Altitude Electro-Magnetic Pulse
HEO ....Highly Elliptical Orbit
HIL ....Human-in-the-Loop
HIO ....High Interest Object
HMMWV...................................High Mobility Multi-Purpose Wheeled Vehicle
HPCMO ....High Performance Computing Management Office
HPM ....High Power Microwave
HQDA ....Headquarters, Department of the Army
HSI ....Hyper-Spectral Imagery
HT ....Heavy Terminal
HWIL ....Hardware-In-the-Loop
IADS ....Integrated Air Defense System
IC ....Intelligence Community
ICAO..International Civil Aviation Organization
ICBM ....Intercontinental Ballistic Missile
ID ....Identification/Identify
I/F...Interface Facilities

IFSAR ....Interferometric Synthetic Aperture Radar
IGEB ....Interagency GPS Executive Board
IMETS ....Integrated Meteorological Systems
INFOSEC....................................Information Security
INSCOM.....................................Army Intelligence Security Command
IO ....Information Operations
IPB ....Intelligence Preparation of the Battlespace/Battlefield
IPL ....Integrated Priority List
IR ....Infrared
ISI..Integrated Space Information Analysis Center
ISR ....Intelligence, Surveillance, and Reconnaissance
ISS..International Space Station
ISSN...Integrated Space Surveillance Network
ITB ....Imagery Intelligence Testbed
ITSO...International Telecommunication Satellite Organization
ITT ....Interactive Training Tool
ITW/AA......................................Integrated Tactical Warning and Attack Assessment
JAGUAR.....................................Joint Air and Ground Unified Awareness
JAOC ....Joint Air Operations Center
JCAPA ....Joint/Combined Arms Precision Attack
JCS ....Joint Chiefs of Staff
JFACC ....Joint Force Air Component Commander
JFLCC ....Joint Force Land Component Commander
JFMCC.......................................Joint Force Maritime Component Commander
JFS ....Joint Feasibility Study
JFSCC ....Joint Force Space Component Commander
JP..Joint Publication
JPO...Joint Program Office
JROC..Joint Requirements Oversight Council
JRSC ....Jam Resistant Secure Communications
JSIC..Joint Space Intelligence Center
JSIMS...Joint Simulation System
JSMB ....Joint Space Management Board
JSST ....Joint Space Support Team
JSTARS ....Joint Surveillance Target Attack Radar System
JTAGS ....Joint Tactical Ground Station
JTF ....Joint Task Force
JTF/CC.......................................Joint Task Force Component Commander
JTIDS ....Joint Tactical Information Distribution System
JV 2010 ....Joint Vision 2010
JWID99 ....Joint Warfare Interoperability Demonstrations 1999
Kbps ....Kilobits Per Second
KE ....Kinetic Energy KE
ASAT ....Kinetic Energy Antisatellite
km ....Kilometer
KW ....Kinetic Weapon

LADAR..Laser Detection and Ranging
LAN ....Local Area Network
LANDSAT...................................Land Satellite (Imaging System)
LCC..Land Component Commander
LDR ....Low Data Rate
LEO..Low Earth Orbit
LEOCOMM.................................Low Earth Orbit Communications
LIDAR ....Laser Identification Detection and Ranging
LNO ....Liaison Officer
LO ....Low Observable
LoD ....Launch on Demand
LPD..Low Probability of Detection
LPI ....Low Probability of Intercept/Launch and Predicted Impact
LRP ....Long Range Plan
LRSU ....Long Range Surveillance Unit
m ....meter
M3P..Multi-Mission Mobile Processor
MABS ....Missile Alert Broadcast System
MAGR ....Miniaturized Airborne GPS Receiver
MAP..Mission Area Plan
MAPS..Mission Area Planning System
MARC...Manpower Requirements Criteria
MASINT ....Measurement and Signals Intelligence
MAST ....Meteorological Automated Sensor and Transceiver
MCG ....Mapping, Charting, and Geodesy
MCS..Maneuver Control System
MDR ....Medium Data Rate
MECC ....Military Education Coordination Conference
MEO..Mid Earth Orbit
METL..Mission Essential Task List
METOC ....Meteorological and Oceanographic
METSAT ....Meteorological Satellite
METT-T......................................Mission, Enemy, Own Troops, Terrain, and Tim
MGES ....Mobile Gateway Earth Station
MGS..Mobile Ground Station
MIC...MILSATCOM Iridium Communications
MIDAS..Miniaturized Data Acquisition System
MIES ....Modernized Imagery Exploitation System
MILSATCOM ....Military Satellite Communications
MIL-STD ....Military Standard
MIRACL.....................................Mid IR Advanced Chemical Laser
MIST ....Multiband Integrated Satellite Terminal
MITT...Mobile Integrated Tactical Terminal
MMBL ....Mounted Maneuver Battle Lab
MOA ....Memorandum of Agreement

MSE ....Mobile Subscriber Equipment
MSI ....Multispectral Imagery
MSS ....Mobile Satellite Services
MSWG ....Modeling and Simulation Working Group
MSX..Midcourse Space Experiment
MT ....Medium Terminal
MTI ....Moving Target Indicator
MTS ....Movement Tracking System
MWC ....Missile Warning Center
NAIC...National Air Intelligence Center
NASA...National Aeronautics and Space Administration
NASM ....National Air and Space Model
NATO ....North Atlantic Treaty Organization
NAV..Navigation
NAVFOR ....Naval Forces
NAVSPACECOM ....Naval Space Command
NAVWAR ....Navigation Warfare
NBC ....Nuclear, Biological, and Chemical
NCA ....National Command Authority
NCIU...National Imagery Transmission Format Standard Communication Interface Unit
NCO ....Noncommissioned Officer
NDP ....National Defense Panel
NEMSS ....National Environmental Monitoring Satellite System
NESDIS ....National Environmental, Satellite, Data, and Information Service
NGO..Non-Governmental Organization
NIMA...National Imagery and Mapping Agency
NITF..National Imagery Transmission Format
NITFS ....National Imagery Transmission Format Standard
NLOS ....Non Line of Sight
NMD ....National Missile Defense
NMS..National Military Strategy
NOAA ....National Oceanic and Atmospheric Administration
NORAD ....North American Aerospace Defense Command
NPOESS......................................National Polar Orbiting Environmental Satellite System
NRO ....National Reconnaissance Office
NRT ....Near Real-Time
NSA ....National Security Agency
NSC...National Space Council/National Security Council
NSP ....National Space Policy
NSSMP ....National Security Strategy Master Plan
NSS ....National Security Strategy
NSSA ....National Security Space Architect
NTC ....National Training Center
NVG..Night Vision Goggles

OASC .... Office of Air and Space Commercialization
OC .... Operational Concept
OCI .... Operational Concept Integrator
OCST .... Office Commercial Space Transportation
OCONUS .... Outside of Continental United States
ODA .... Optical Data Analysis
ODOC .... Objective DSCS Operations Center
O&M .... Operations and Maintenance
OOTW .... Operations Other Than War
OPMS .... Officer Personnel Management System
OPSEC .... Operations Security
ORD .... Operational Requirement Document
OSA .... Office of the Space Architect
OSD .... Office of the Secretary of Defense
OSF .... Operational Support Facility
PAC-3 .... Patriot Advanced Capability Three
PACOM .... Pacific Command
PAM .... Pamphlet
PANAMSAT .... Pan American Satellite System-Commercial Name
PCP .... Precision Code Protected
PCS .... Personal Communications Services
PDD .... Presidential Decision Directive
PEO .... Program Executive Office
PLGR .... Precision Lightweight GPS Receiver
PME .... Professional Military Education
POC .... Point of Contact
POES .... Polar Orbiting Environmental Satellite
POM .... Program Objective Memorandum
POS/NAV .... Position/Navigation
PPBES .... Programming, Planning, Budget Execution System
PPS .... Precision Positioning Services
PPS-M .... Precision Positioning Services-Security Module
PSCCE .... Production Satellite Configuration Control Element
PSM .... Portable Space Model
PVO .... Private Volunteer Organization
QT&E .... Qualification Test and Evaluation
R&D .... Research and Development
RBV .... Rapid Battlefield Visualization
RDEC .... Research, Development, and Engineering Center
RDT&E .... Research Development Test and Evaluation
REG .... Regulation
RF .... Radio Frequency
RIDSN .... Radar Imaging and Deep Space Network
RISTA .... Reconnaissance, Intelligence, Surveillance, and Target Acquisition
RLV .... Reusable Launch Vehicle

RMA ....Revolution in Military Affairs
ROE ....Rules of Engagement
ROTC....Reserve Officer Training Corps
R&S ....Reconnaissance and Surveillance
RSCCE....Replacement Satellite Configuration Control Element
RT ....Real Time
RTM....Run Time Manager
SA ....Space Architect/Situational Awareness/Selective Availability
SAGR....Standalone Air GPS Receiver
SAR....Synthetic Aperture Radar
SATCOM....Satellite Communications/Satellite Command
SATOPS....Satellite Operations
SBC....Synthetic Battle Center
SBE ....Synthetic Battlefield Environment
SBEON ....Space-Based Electro-Optical Network
SBI ....Space-Based Interceptor
SBIRS ....Space-Based Infrared System
SBIRS-H ....SBIRS- High
SBIRS-L....SBIRS- Low
SBJ ....Space-Based Jammer
SBL ....Space-Based Laser
SBP ....Space-Based Platform
SBR....Space-Based Radar
SC....Simulation Center
SCAMP....Single Channel Anti-Jam Man Portable
SCC....Space Control Center
SCI ....Sensitive Compartmented Information
SCDL ....Secure Communications Data Link
SCPS ....Satellite Communications Protocol Standards
SECARMY ....Secretary of the Army
SECDEF....Secretary of Defense
SEL ....Space Education Literacy
SEP....Spherical Error Probable
SHF ....Super High Frequency
SIAM ....Space and Information Analysis Model
SID ....Secondary Imagery Dissemination
SIDEARM ....Secondary Imagery Dissemination Environment and Resource Manager
SIGINT ....Signals Intelligence
SIPRNET ....Security Internet Protocol Routing Network
SITAC....Spectral Information Technology Applications Center
SLBM....Sea-Launched Ballistic Missile
SLEP ....Service Life Extension Program
SLGR ....Small Lightweight GPS Receiver
SMART-T....Secure Mobile Anti-Jam Reliable Tactical Terminal

SMC ....Space and Missile Command
SMDBL.......................................Space and Missile Defense Battle Lab
SMDC ....Space and Missile Defense Command
SMDTC.......................................Space and Missile Defense Technical Center
SOC...Space Operations Center
SOCOM ....Southern Command
SOF ....Special Operations Forces
SOI ....Space Object Identification
SOLGR ....Special Operations Lightweight GPS Receiver
SOS ....System of Systems
SOV ....Space Operations Vehicle
SPACECOM...............................Space Command
SPIN..SATCOM Planning Information Network
SPIRIT ....Special Purpose Integrated Remote Intelligence Terminal
SPOC ....Space Operations Center (USSPACECOM)
SPOT...Satellite Probatoire d'observation de la Terre
SPS..Standard Positioning Service
SRDP ....Space Requirements and Determination Process
SSDC ....Space and Strategic Defense Command
SSG ....Senior Steering Group
SSN ....Space Surveillance Network
SSR ....System Specific Representation
ST..Space Transport
STAR-T ....SHF Tri-band Advanced Range Extension Terminal
STEP ....Standardized Tactical Entry Point
STRATCOM...............................Strategic Command
STO...Science and Technology Objective
STT ....Small Tactical Terminal
SUCCESS ....Synthesized UHF Computer Controlled Equipment Subsystem
SWAM ....Soldier Warning and Messaging
SWC..Space Warfare Center
TAC v2 ....Tactical Communication Protocol version 2
TADIL-B ....Tactical Data Link-B
TAP...The Army Plan
TASM ....Tactical Air to Surface Missile
TASR ....Tactical Automated Situation Receiver
TAV ....Total Asset Visibility
TAVSCOMS...............................Tactical Vehicle Smart Communication Switch
TBM..Theater Ballistic Missile
TD ....Technology Demonstration/Training Development
T&E ....Test and Evaluation
TEC...Topographical Engineering Center
TENCAP.....................................Tactical Exploitation of National Capabilities
TEL ....Transporter Erector Launcher

TES ....Theater Event System/Tactical Exploitation System
THAAD ....Theater High Altitude Air Defense
THEL ....Tactical High Energy Laser
TIBS ....Tactical Information Broadcast Service
TMD ....Theater Missile Defense
TOC ....Tactical Operations Center
TOS ....Transportable Optical System
TP ....TRADOC Pamphlet
TPN ....Tactical Packet Network
TPS ....Thermal Protection System
TRAC ....TRADOC Analysis Command
TRADEX ....Tracking and Discrimination Experiment
TRAM ....Transit MDR
TRANSCOM ....Transportation Command
TRANSEC ....Transmission Security
TRAP ....Tactical and Related Applications
TRADOC ....Training and Doctrine Command
TRI-TAC ....Tri-Service Tactical Communications
TSIU ....Tactical Simulation Interface Unit
TSS ....Tri-band SATCOM Subsystem
TT&C ....Telemetry, Tracking and Commanding
TTP ....Tactics, Techniques, and Procedures
TW/AR ....Threat Warning/Attack Reporting
TWV ....Tactical Wheeled Vehicles
UAV ....Unmanned Aerial Vehicle
UCP ....Unified Command Plan
UFO ....UHF Follow-on
UHF ....Ultra High Frequency
UMS ....Universal Model System
US ....United States
USAF ....United States Air Force
USARSPACE ....United States Army Space Command
USASMDC ....United States Army Space and Missile Defense Command
USCENTCOM ....United States Central Command
USCINCSPACE ....Commander in Chief, United States Space Command
USD (A & T) ....Under Secretary of Defense for Acquisition and Technology
USEUCOM ....United States European Command
USI ....Ultra-Spectral Imagery
USJFCOM ....United States Joint Forces Command
USMTF ....United States Message Text Format
USN ....United States Navy
USNAVSPACECOM ....United States Naval Space Command
USPACOM ....United States Pacific Command
USSOCOM ....United States Special Operations Command

USSPACECOM ....United States Space Command
USTRANSCOM ....United States Transportation Command
VCSA ....Vice Chief of Staff, United States Army
VMF...Variable Message Format
WF ....Warfighter
WF-1 ....Warfighter-1
WHCA ....White House Communications Agency
WMD ....Weapons of Mass Destruction
WRAP ....Warfighting Rapid Acquisition Program
WRC ....World Radiocommunications Conference
WSMC ....Western Space and Missile Center
WTEM ....Weather, Terrain, and Environmental Monitoring
WIN-T..Warfighter Information Network-Terrestrial
WWMCCS..................................Worldwide Military Communication Command and Control System
WWW ....World Wide Web

Annex B: Glossary

Access ....A channel allocated to a specific user for a specific period of time.

Anti-Jam ....Resistant to signals which would interfere with reception of the desired communications. Jamming is not necessarily hostile and can be caused by unintentional use of the system or improperly tuned equipment.

Apogee ....The point in a satellite's orbit where it is farthest from the Earth and its velocity is slowest.

Asynchronous Transfer Mode .....This is the new form of super-fast packet switching. In the 21st century ATM networks will operate at speeds of gigabits per second.

Bandwidth ....The width of a given band or spectrum of frequencies of interest, expressed in hertz. The lowest usable frequency subtracted from the highest usable frequency for a communication channel gives its bandwidth. Generally, higher bandwidth channels have greater capacity to convey signals modulated with higher data rates of information.

Baud ....The number of pulses per second or the number of times per second that a signal on a communication circuit changes.

Beamwidth ....The angle of the conical shaped beam that an antenna radiates. Large antennas have narrower beamwidths and can pinpoint satellites in space or dense traffic areas on the Earth more precisely. Tighter beamwidths deliver higher levels of power and thus greater communications performance.

Bent Pipe ....A non-regenerative non-processed channel that does nothing to the signal received by the satellite, except to relay it toward Earth.

Circular Orbit ....Any orbit that has an eccentricity of zero. Since all satellites are subject to perturbations, no orbit can achieve and maintain an eccentricity of exactly zero. Common practice is to call orbits with very low eccentricities circular.

Constellation ....A number of like satellites that are part of a system. Satellites in a constellation generally have the same type orbit, although that is not a requirement.

Control Segment ....That portion of a space system that controls the satellite platform, payload, and network. This segment provides for station-keeping, orbital changes, attitude and stabilization changes, and other satellite maintenance and housekeeping activities.

Crosslink ....A communications link between satellites, usually a microwave, millimeter wave, or laser signal with a narrow beamwidth. Crosslinked satellites provide connectivity to satellites that are out of view of ground stations.

DAMA ....Demand Assigned Multiple Access. An efficient method of managed channel access allowing the sharing of one or more channels by multiple users. A control system providing satellite access to customers on a priority and need basis. DAMA reduces the amount of unused (wasted) satellite channel availability time.

Downlink ....A communications channel from a satellite to an Earth station.

Elliptical Orbit ....Any orbit that is not perfectly circular is elliptical. The term is normally used to describe orbits that vary significantly from circular.

Ephemeris Data............................Information needed to establish a link to a satellite, including look angles in elevation and azimuth.

Equatorial Orbit ....Satellites in equatorial orbit are, by definition, inclined at zero degrees. All geostationary orbits are also equatorial orbits.

Footprint.......................................A satellite's footprint is that area on the Earth's surface covered by the satellite antenna's beam pattern or within the field of view of the satellite's transmitters or sensors.

Frequency Hopping......................Discrete jumping of a signal's transmitted frequency over time. Used to counter jamming or other interference.

Full Duplex ....Able to communicate both ways (transmit and receive) simultaneously.

Gapfiller ....A commercial satellite capability leased by the Navy to provide UHF communications. Originally built to fill the gap preceding the FLTSAT launches, they still provide SATCOM service for DOD. Will be replaced by UHF Follow-on. (UFO utilizes Gapfiller frequencies.)

Geostationary Orbit......................A special type of geosynchronous orbit which is nearly circular, has an inclination of approximately zero degrees, and a period of one day. A satellite in geostationary orbit appears to remain fixed in the sky above the equator when observed from the earth's surface. A typical geostationary orbit has, at an altitude of approximately 22,300 miles over the equator, an orbital period of 24 hours thus coinciding with the rotation period of the Earth.

Geosynchronous Orbit ....Any orbit with an orbital period of one day. A satellite in a geosynchronous orbit does not necessarily appear to be stationary in the sky to an observer on the surface of the Earth. A geosynchronous satellite in an inclined, circular orbit will sweep out a Ground Trace in the shape of a figure eight.

Guardband ....Spacing between channels to prevent adjacent channel interference.

Half Duplex ....Can only communicate in one direction at one time (receive or transmit.)

Inclination ....The angle between the plane of the orbit of a satellite and a reference plane. For a satellite in Earth orbit, inclination is the angle between the orbital plane and the equatorial plane as the satellite crosses the equator northward. Inclination values may be any angle between zero and 180 degrees.

Molniya Orbit ....A highly inclined (typically about 63.4 degrees), highly elliptical orbit with a 12-hour period.

Nadir ....The point on the Earth's surface directly below the satellite.

Payload..That portion of the load on the satellite for which a customer is willing to pay. Also, in general terms, the satellite to be delivered by the rocket.

Perigee ....The point in a satellite's orbit where it is closest to Earth and its velocity is highest.

Period ....The length of time it takes for the satellite to complete one orbit.

Phased Array Radar ....Any of a class of radars that, instead of using a rotating dish antenna to scan, uses electronically steered beams. The typical coverage of this fixed radar is 120 degrees per face or side; a phased array radar with three faces can provide coverage in all directions.

Regenerative Channel ....On a regenerative channel, the satellite receiver converts the data signal (from the ground or airborne terminal) back into its original "ones" and "zeros." The satellite then uses those "ones" and "zeros" to retransmit the data toward the Earth to the receiving terminal.

Satellite ....An object in space that is in orbit around another more massive object.

Slot ....That longitudinal position in the geosynchronous orbit into which a communications satellite is "parked." Above the U.S., communications satellites are typically positioned in slots which are based at two to three degree intervals.

Space Segment ....That portion of a space system (see below) that is located in space, i. e., the satellite.

Space System ....An organization made up of equipment, some of which is in space, and people whose purpose is to perform specific technical tasks with the equipment. Space systems are almost universally made up of three principle subsystems, or segments; the space segment (satellite), the user segment (equipment and persons used to exploit the satellite's products), and the control segment (equipment and persons dedicated to maintaining the satellite).

Spot Beam ....A focused antenna pattern sent to a limited geographical area. Spot beams are used to deliver certain transponder signals to geographically well-defined areas such as Hawaii, Alaska, and Puerto Rico.

Uplink ....The Earth-to-space telecommunications pathway.

User Segment...............................That portion of the space system that is ground-based and provides useful products. This may consist of receivers, processors, and special support personnel at a fixed site, or a simple portable radio that provides satellite access.

Wavelength ....Wavelength is literally the length of one complete cycle (wave) of an electromagnetic signal. In radio signal terms, for example this can be determined by dividing the speed of light in meters per second (about 300,000,000) by the frequency, measured in hertz (also known as cycles per second). The result will be wavelength in meters. Wave length is an important favor in antenna design.

Annex C: Space Future Operational Capabilities

SP 97-001. Space Sensors Linked With Terrestrial Systems

The capability for accurate and timely sensor information processing and delivery to the operational and tactical level is required to support decision making, planning and combat operations. This information must be available from throughout the battlespace on both friendly and hostile force disposition to include force location, its combat readiness, and strength. The ability to “see” the battlespace is required, including identification and tracking of the full range of materiel. Various types of sensors are needed to operate in the full range of the electronic and visible spectrum. These sensors can be space-based and/or terrestrial.

SP 97-002. Passive and Active Target Detection and Processing

The capability to monitor, detect, and alert ground forces to both passive and active targets of military interest across the full range of the electromagnetic spectrum and in all operational patterns is required. The sensor must be able to distinguish the true target from the false one with a high degree of confidence so that targeting with both precision and non-precision weapons is possible. The ability to rapidly cue and cross correlate space sensors with terrestrial sensors to improve target accuracy and identification is desired.

SP 97-004. Support Battle Damage Assessment

The capability for space sensors to assist in the processing and assessment of battle damage is required. The sensors with their associated links, interfaces, and terrestrial support/automation systems must give an initial indication of damage in sufficient time to determine the need for further engagement of the target, while also permitting post-strike assessments. The space sensor data needs to be correlated with other target data.

SP 97-005. Space Simulation and Modeling Tools

To support accurate decisions concerning the impacts of space capabilities on ground forces, a capability to model all segments of space (including space platforms and components, links, and terrestrial systems) is required. This includes sufficient fidelity in appropriate architectures, concept simulations, as well as training, exercises, and military operations. Space models and simulations need to be developed and acquired to allow for their use in determining specific system requirements, both space and terrestrial, prior to developing or acquiring new systems or upgrades.

SP 97-007. Interoperability

The capability for Army space systems to interoperate / interface with other U.S. and foreign government and commercial space systems and data architectures is required. This includes the interoperability of space platforms among themselves, as well as terrestrial systems interoperability to space platforms, and interfaces between terrestrial systems. The security measures implemented must allow for interoperability and sharing of information as required, but also allow for termination/denial of information when no longer desired / required. Implementation of these security measures should require minimal time and labor impact on the user, while allowing for multiple configurations.

SP 97-008. Responsive and Reliable Network Architecture

The network capability is required for Army Space systems to provide assured receipt of information. Networks must be responsive to changes in configuration and control and must be robust enough to avoid single points of failure. Critical functions must be redundant. All systems' networks and architectures must be flexible and adaptable to changes in management without undue time lag or increasing workload on system operators, management personnel, and users. Irrespective of the configuration and type of management changes no degradation to the system or network should occur from either natural or man-made causes.

SP 97-009. Real Time Prioritized Information Dissemination

The capability for space systems and supporting terrestrial segments to provide real-time dissemination of critical data/information is required. The system will provide data directly without numerous entry points and subsequent relay points. Data pertaining to critical areas of operations, to include Missile Defense, NBC, high priority targets, and post-strike assessments, must be provided on a priority basis to designated weapons platforms and appropriate echelons of command.

SP 97-011. Standardization of Battlespace Data

The capability is required for space systems to provide architecture-compliant standardized data, to allow for its processing, automation, manipulation, and display for command, control, planning, and assessments. The data format must meet security requirements, yet be compatible with all planned U.S. Government, commercial, and non-U.S. systems.

SP 97-012. Survivable Systems with Low Probability of Intercept

The capability for space platforms to survive all known and projected threats is required. Established environmental and survivability standards must be met. Space platforms need an organic capability to detect and correct hardware and software errors, to recognize threats, and to take evasive maneuvers and countermeasures without degrading mission performance. When one platform detects a threat to another space platform it must have the means to warn the threatened platform and its controlling agencies in a timely manner.

SP 97-014. Collection and Dissemination of Mapping, Charting, and Geodesy (MCG) Data

The capability for the Army to generate electronic maps, on the move, to support the operational and tactical level of command around the globe is required. Space systems are integral in insuring MCG data is current and of sufficient detail, and must be able to support MCG requirements of all echelons from small unit to theater level.

SP 97-015. Collection and Dissemination of Targeting Data (All Sources)

During all levels of conflict specific types of targets and targetable events in named areas of interest must be transmitted as rapidly as possible at the proper resolution and fidelity to weapons platforms able to engage, negate, or defeat the target. This information must be in the format that is compatible with current Army and joint operations programs and systems. Space assets are critical in insuring that the targeting information is disseminated in a timely manner to allow for tasking and transmission of this specific type of mission.

SP 97-016. Automatic/Aided Target Recognition (ATR)

The capability for rapid detection and identification of a wide variety of targets is essential for Army operations. Assisted or automated target recognition is required to reduce operator workload and inaccuracies. The target identification should be compatible with fire command formats and make prioritized recommendations of specific units/ weapons systems, based upon METT. To further reduce data processing and transmission timelines, incorporation of some ATR on space platforms is required. ATR is required to be interoperable with other Army joint and allied/friendly battlefield management systems.

SP 97-017. Continuous and Global Satellite Coverage

The capability is required for the Army to have satellite coverage of all land masses and to have continuous access while on the move to agencies and databases of U.S., friendly, and allied governments, around the globe. Army forces must have unencumbered access to planning and operational information from the earliest possibility through all phases of deployment. As required the Army should have access to dedicated space terminals on other service and DOD platforms to plan and perform Army missions.

SP 97-018. Army Space Qualified Personnel

The Army requires a Total Force core of “Space smart” personnel able to plan, project, budget, integrate, operate, train, and maintain Army Space systems and space system support. This requires supporting infrastructure at various locations in CONUS and OCONUS to perform these missions. A process must be developed for identification, training and education, career progression, and functional area recognition for Space personnel. Army courses must take advantage of and leverage existing and future USAF and DOD joint opportunities. However, where unique Army requirements exist, proper instruction and facilities, with all required support, will be developed to support these requirements.

SP 97-019. Army Support for Modular Satellite Construction

In conjunction with the other services, the Army requires a capability for a modular space platform to enable new sensors, processors, and other components to be developed and remain near state of the art. Common/ interoperable buses allow the final configuration of the platform to be determined quickly and then rapidly assembled. Benefits of this approach are the quick replacement of damaged or destroyed platforms and the ability to tailor a platform for augmentation of missions or areas.

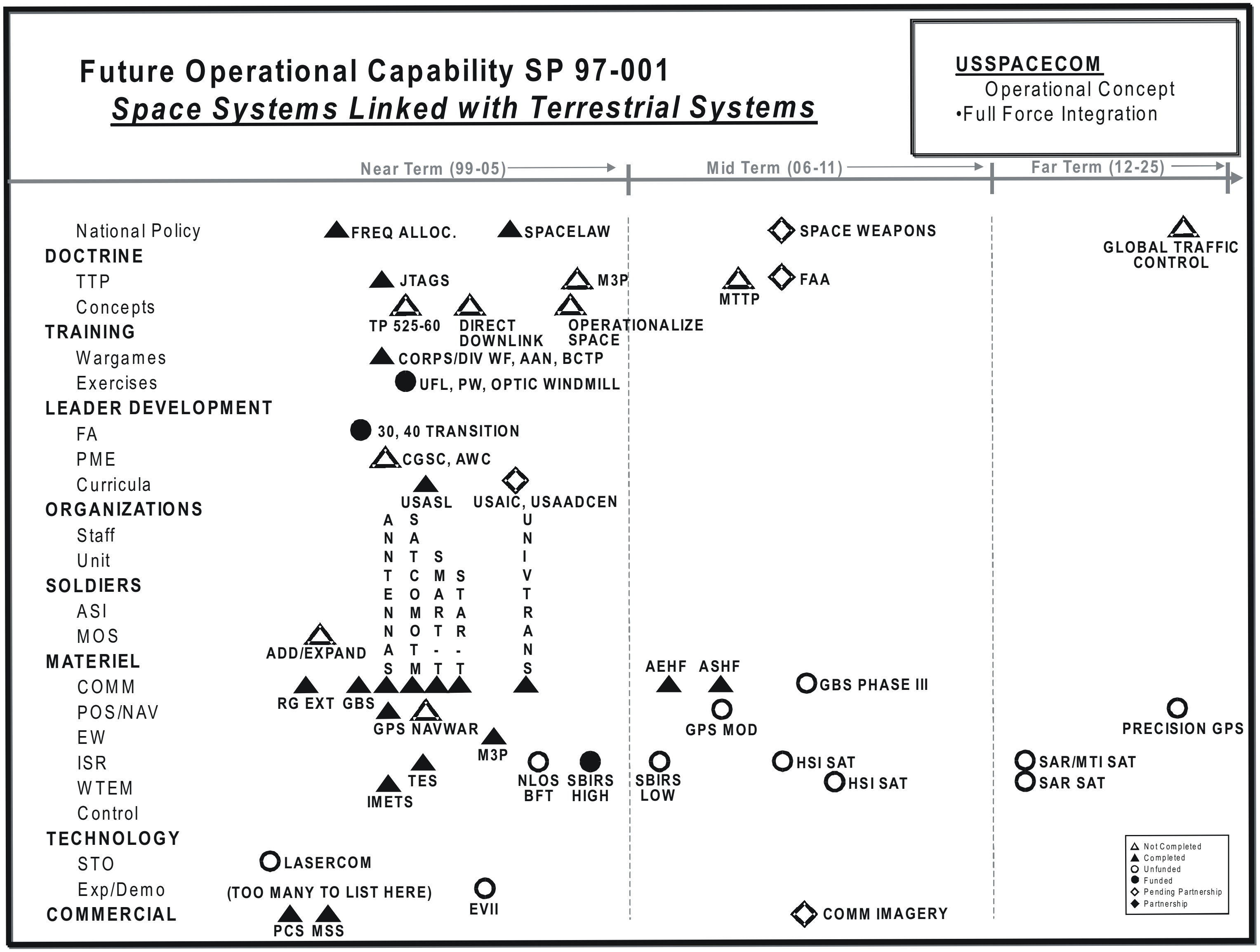
SP 97-020. Theater Missile Defense

Space sensor capabilities are required to conduct offensive and defensive operations against the enemy missile forces, specifically CM, tactical ballistic missiles and TASMs. To counter this threat, these sensors must be capable of:

- Detecting TBM missile classes during the boost phase, and tracking missiles & aircraft in flight. This data is essential to active defense systems, and must be transmitted immediately to ground processing segments for further dissemination and incorporation into the IADS single integrated air picture.
- Detecting missiles early enough in its trajectory to provide sufficient early warning to affected units.
- Developing targeting data concerning enemy missile launch points accurately and timely enough to allow the Force Commander to react within the enemy decision cycle, and allow for targeting of enemy missile assets to interrupt or prevent launching of enemy missiles.

SP 97-021. Offensive Space Control

A treaty compliant offensive capability is required from both terrestrial and space locations to allow U.S. forces to gain and maintain control of activities in space. This includes capabilities to conduct surveillance of threat space systems and terrestrial links and the lethal/ non-lethal ability to deny, deceive, disrupt, degrade, or destroy enemy space infrastructure.


Future Operational Capability SP 97-001
Space Systems Linked with Terrestrial Systems
USSPACECOM
Operational Concept
•Full Force Integration
Near Term (99-05)
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CORPS/DIV WF, AAN, BCTP
UFL, PW, OPTIC WINDMILL
30, 40 TRANSITION
CGSC, AWC
USASL
USAIC, USAADCEN
ANTENNAS
SATCOM OTM
SMART-T
STAR-T
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ASHF
GBS PHASE III
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NAVWAR
GPS MOD
PRECISION GPS
M3P
NLOS BFT
SBIRS HIGH
SBIRS LOW
HSI SAT
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SAR/MTI SAT
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Future Operational Capability SP 97-002

Passive and Active Target Detection and Processing

USSPACECOM
Operational Concept
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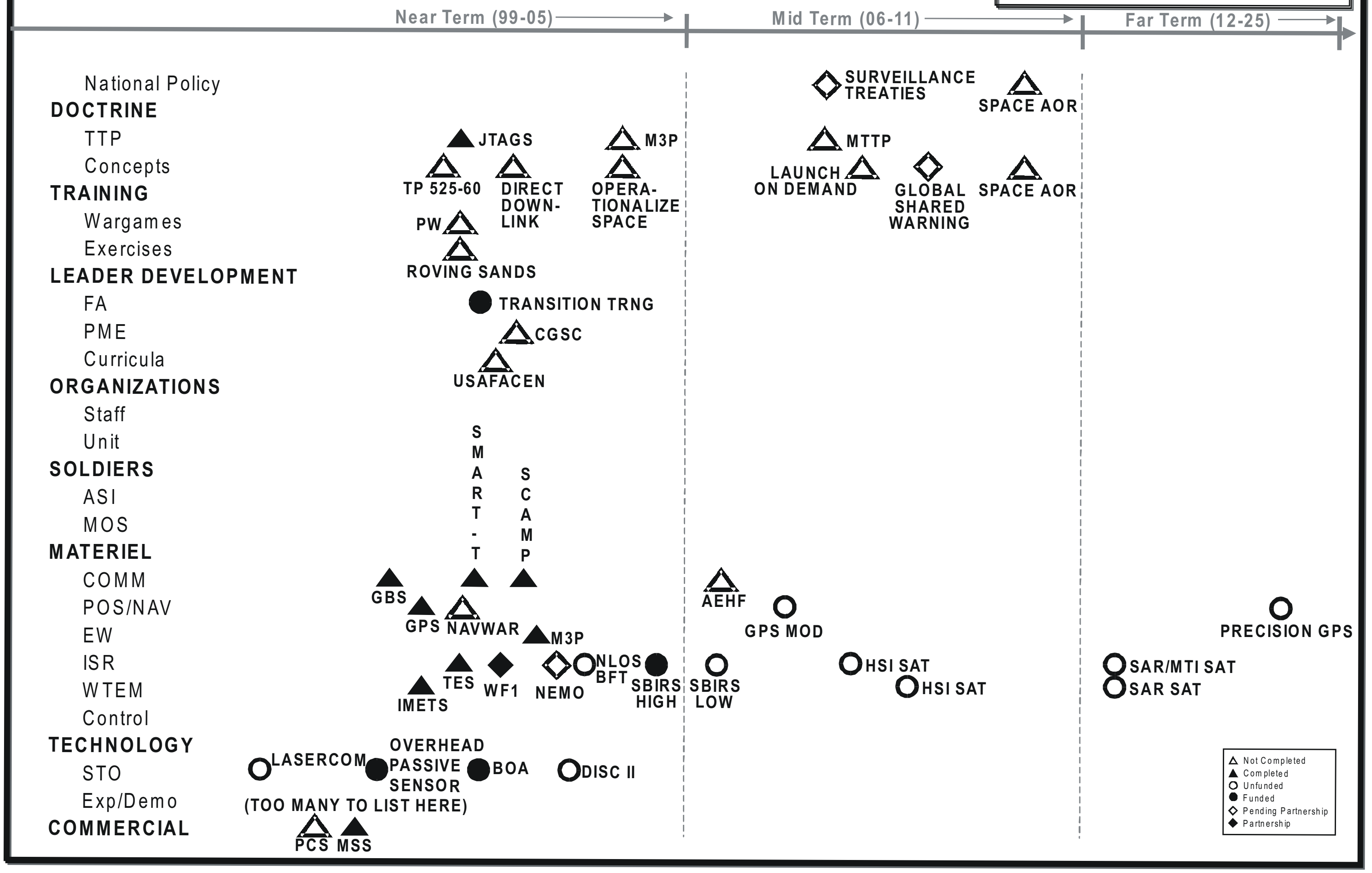

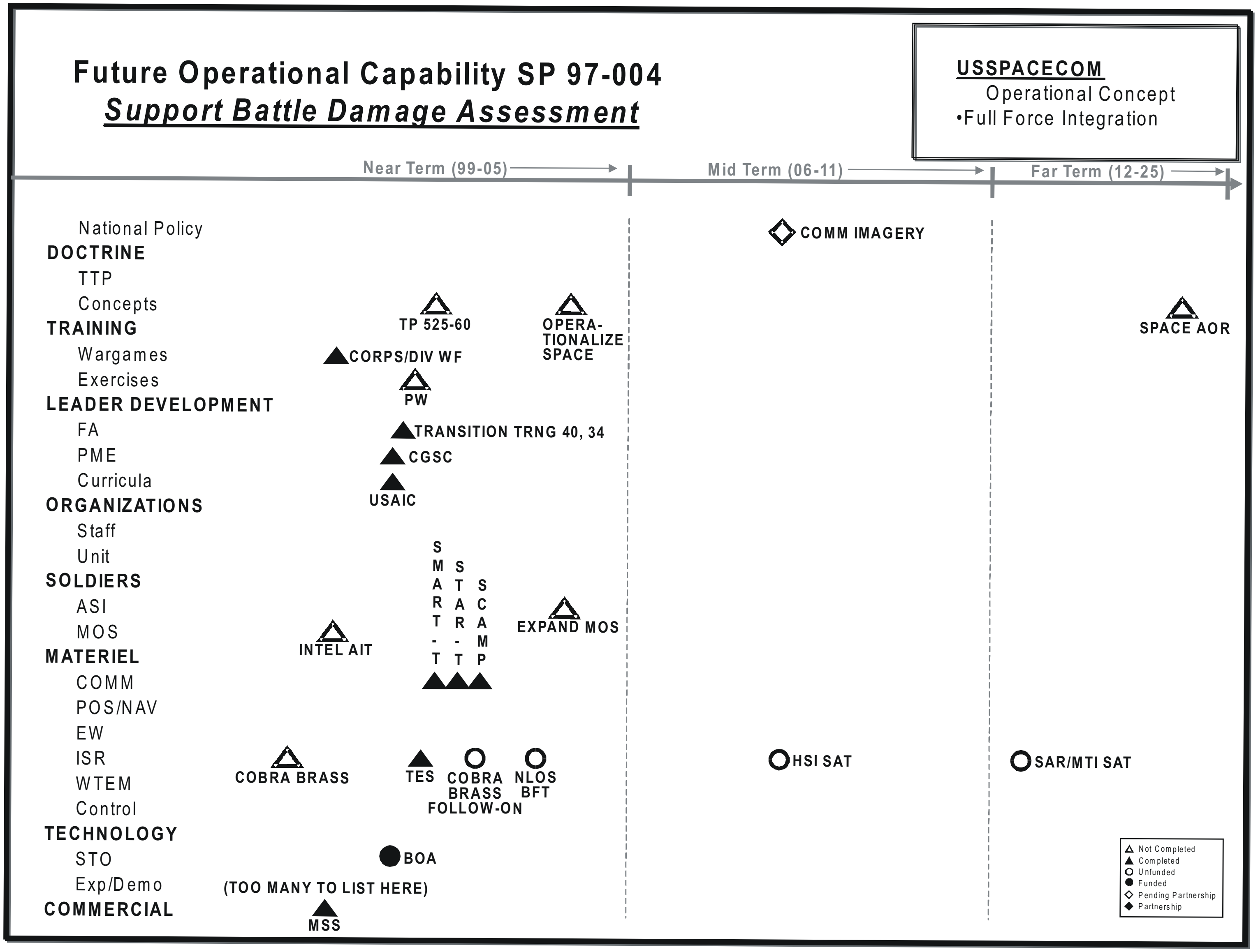
Future Operational Capability SP 97-004
Support Battle Damage Assessment
USSPACECOM
Operational Concept
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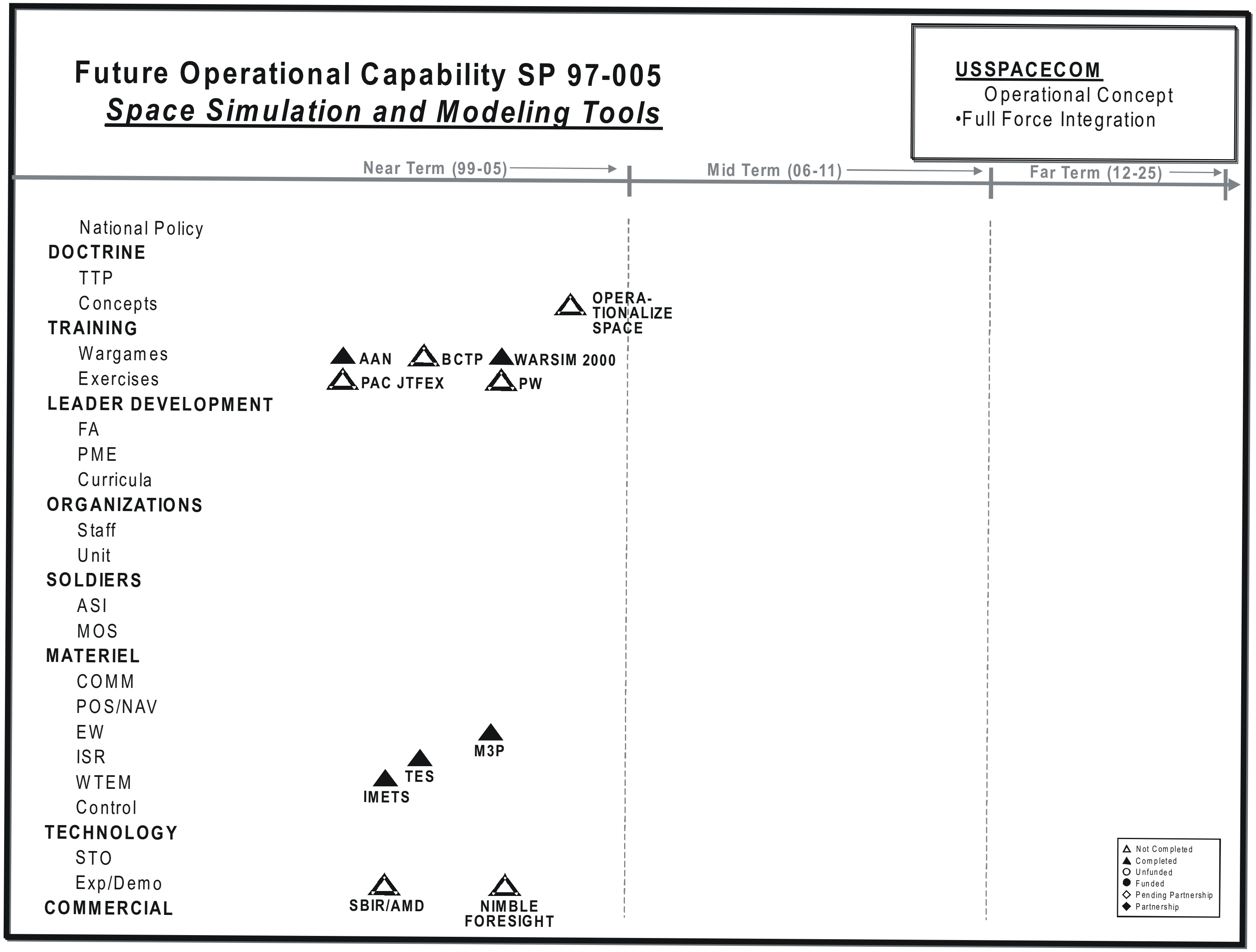

Future Operational Capability SP 97-005
Space Simulation and Modeling Tools
USSPACECOM
Operational Concept
•Full Force Integration
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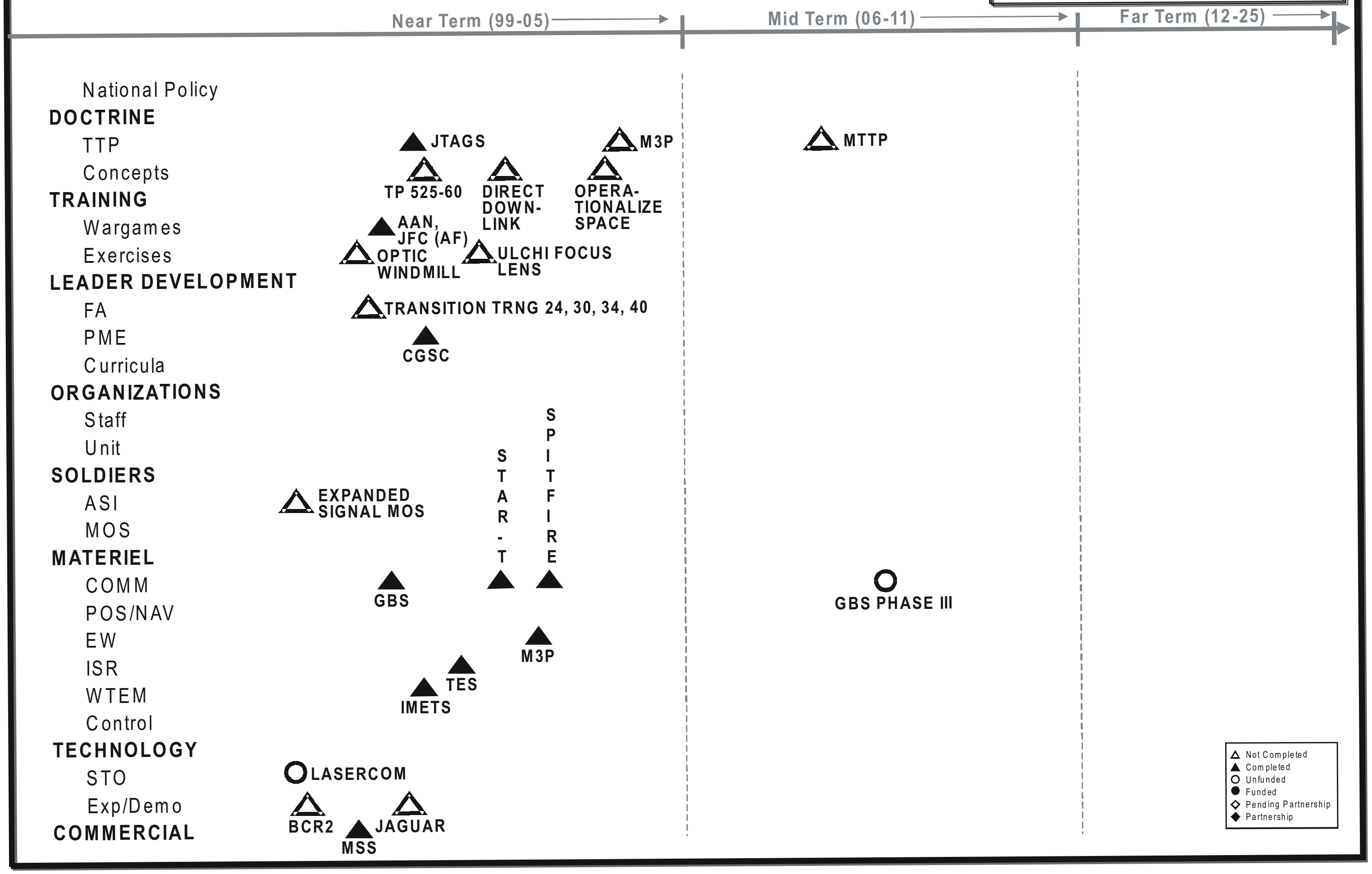
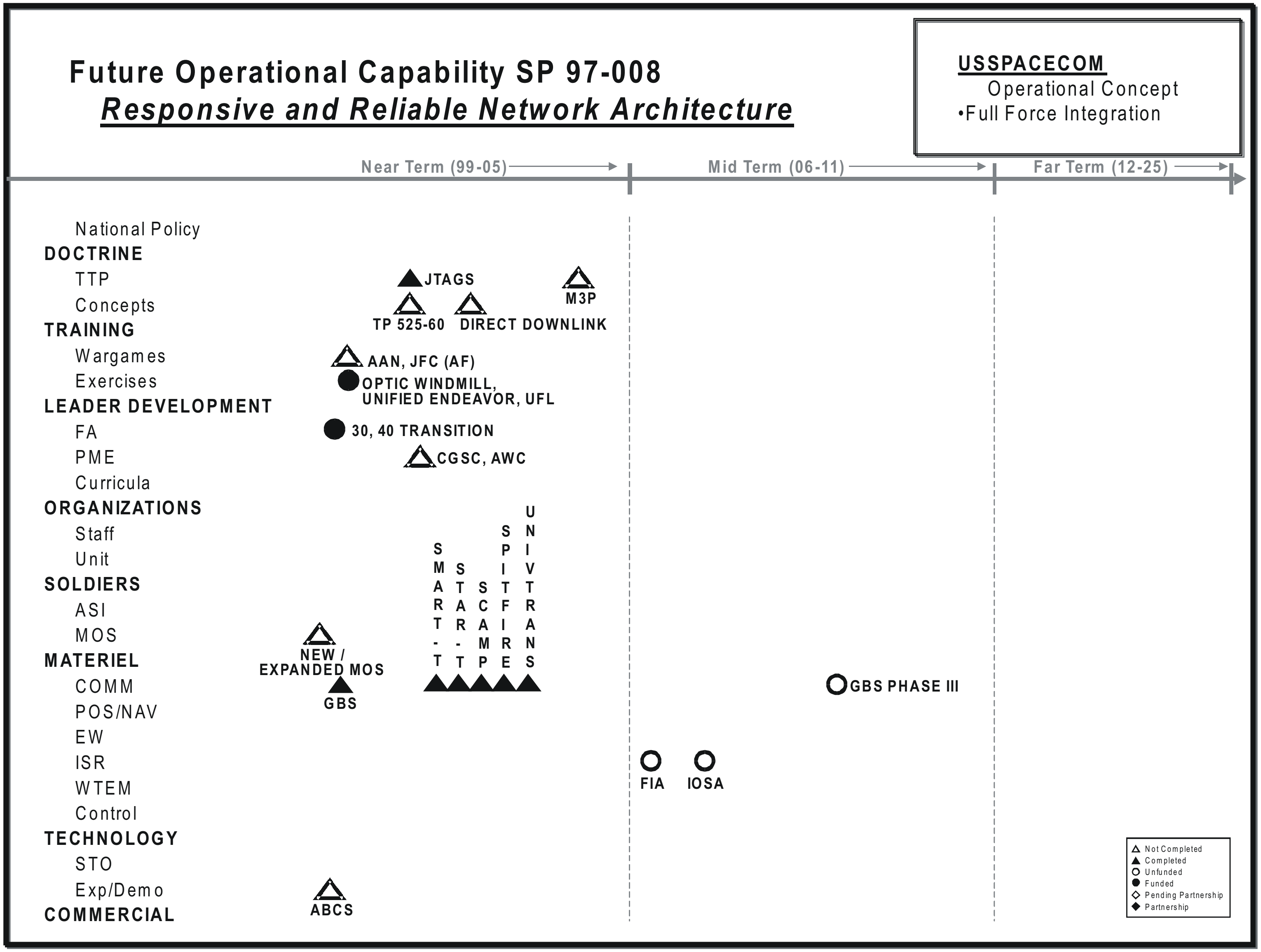
Future Operational Capability SP 97-007

Interoperability

USSPACECOM
Operational Concept
•Full Force Integration




Future Operational Capability SP 97-008
Responsive and Reliable Network Architecture
USSPACECOM
Operational Concept
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AAN, JFC (AF)
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30, 40 TRANSITION
CGSC, AWC
NEW / EXPANDED MOS
GBS
SMART-T
STAR-T
SCAMP
SPITFIRE
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GBS PHASE III
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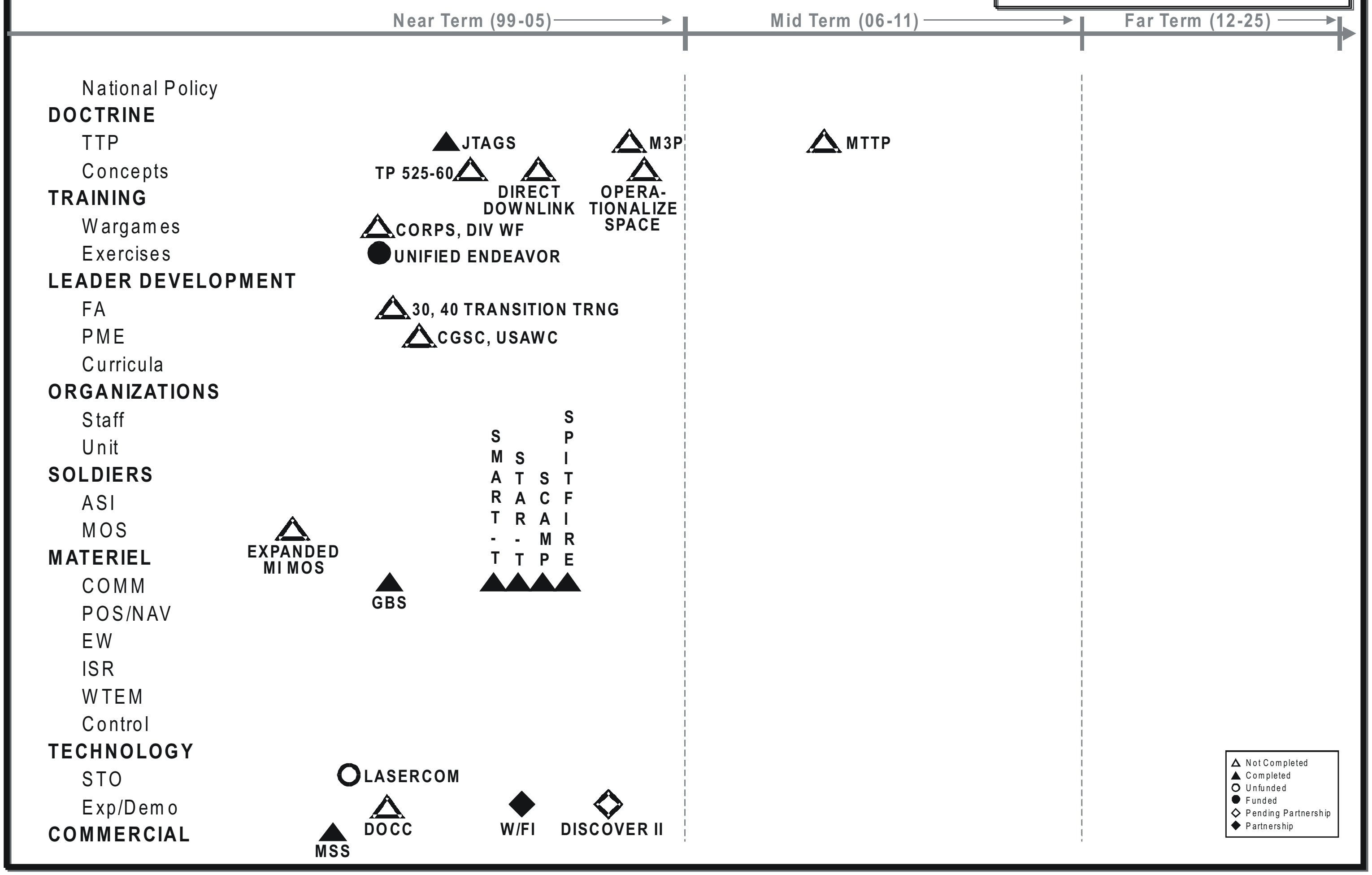
Future Operational Capability SP 97-009

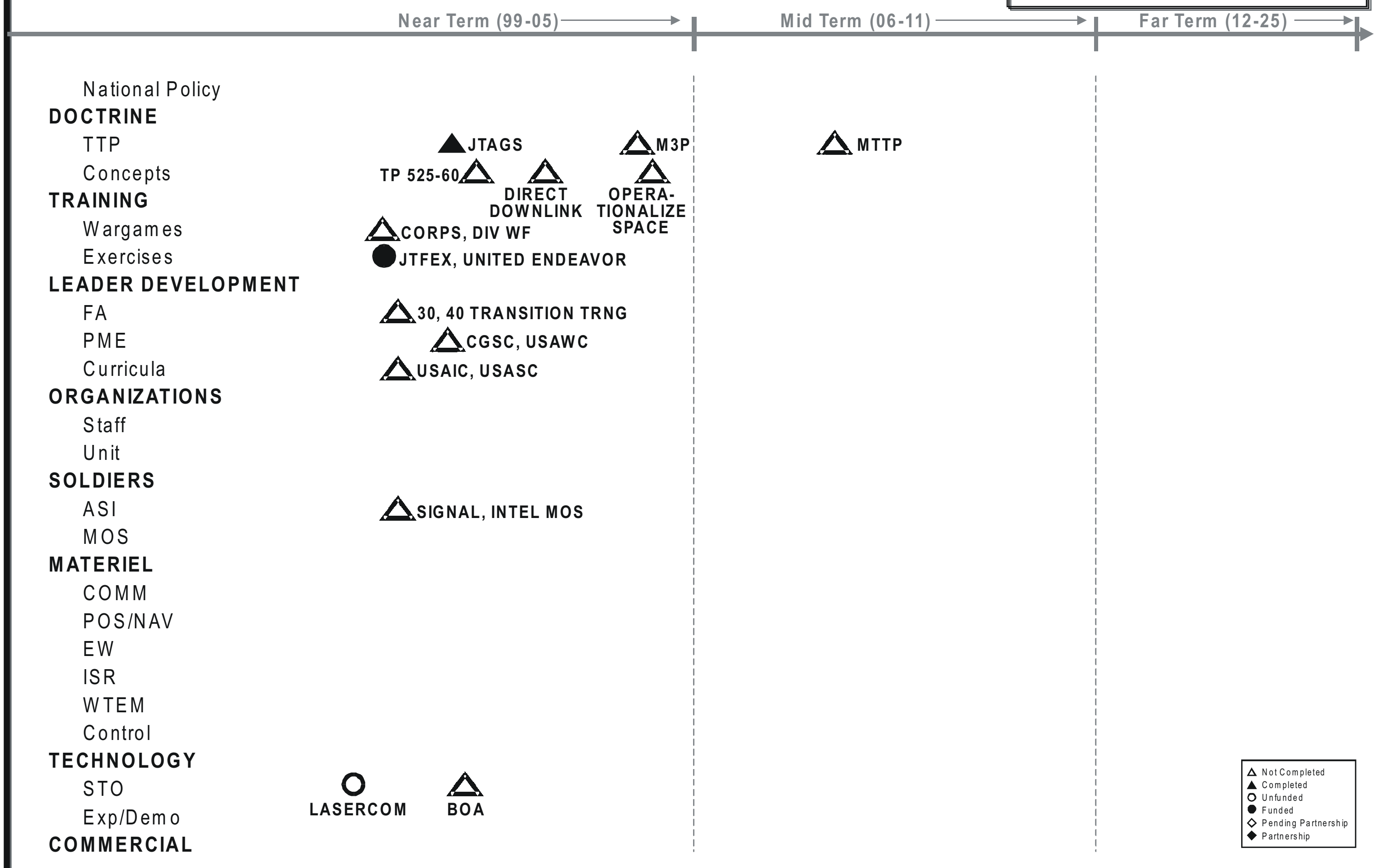
Real Time Prioritized Information Dissemination

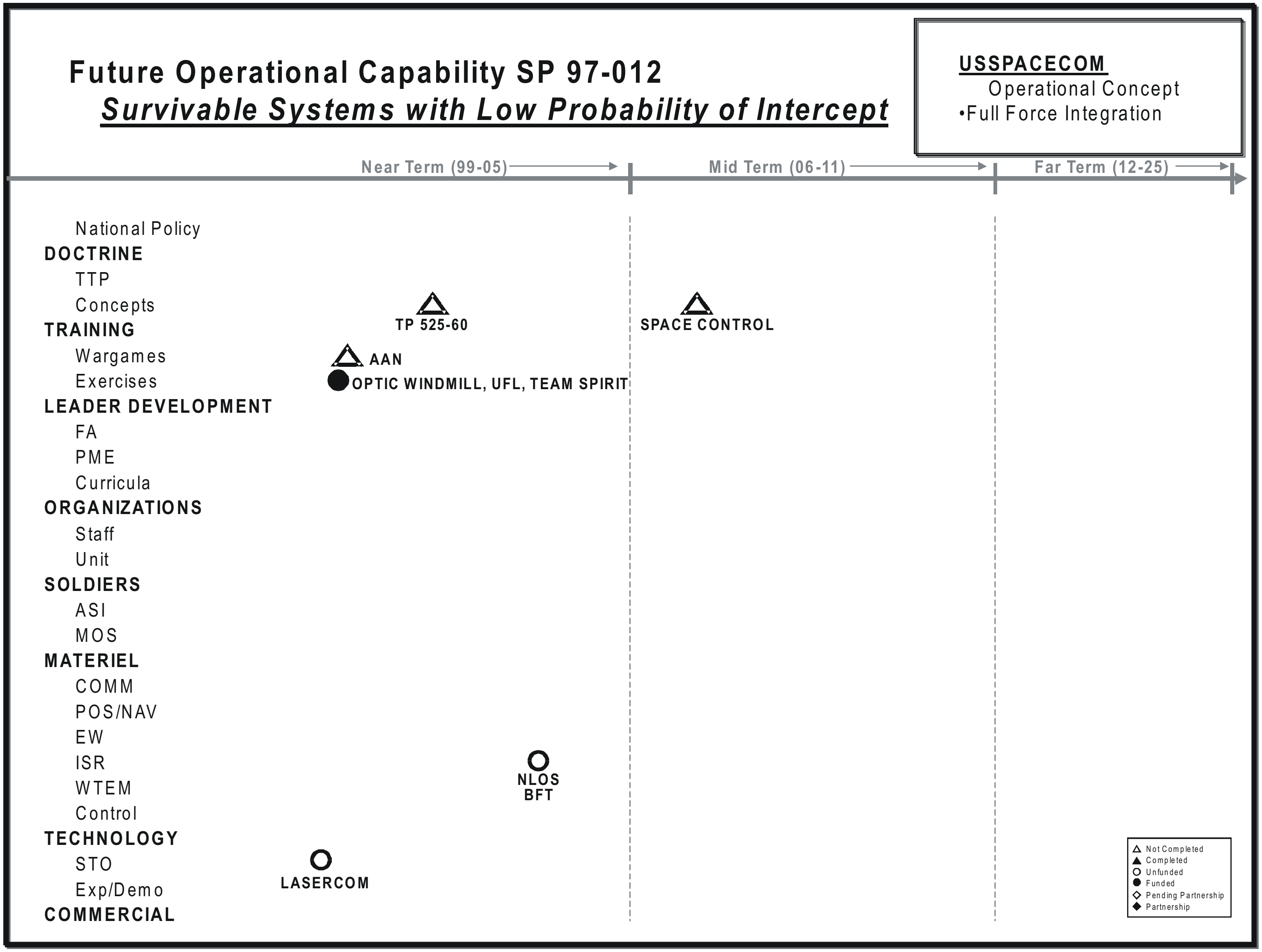
USSPACECOM
Operational Concept
•Full Force Integration



Future Operational Capability SP 97-011
Standardization of Battlespace Data

USSPACECOM
Operational Concept
•Full Force Integration





Future Operational Capability SP 97-012
Survivable Systems with Low Probability of Intercept
USSPACECOM
Operational Concept
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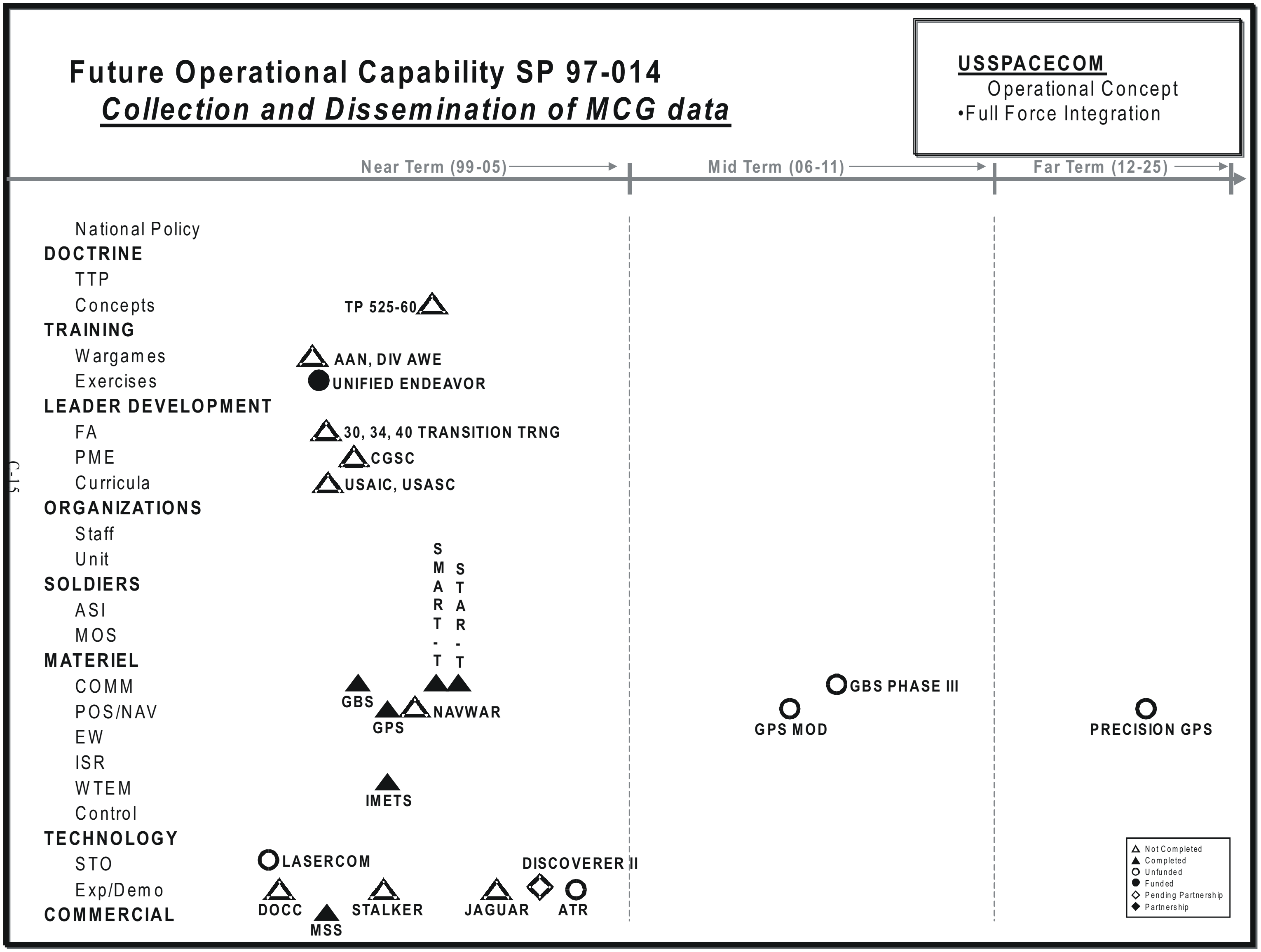

Future Operational Capability SP 97-014
Collection and Dissemination of MCG data
USSPACECOM
Operational Concept
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UNIFIED ENDEAVOR
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CGSC
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SMART-T
STAR-T
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GPS
NAVWAR
GBS PHASE III
GPS MOD
PRECISION GPS
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LASERCOM
DISCOVERER II
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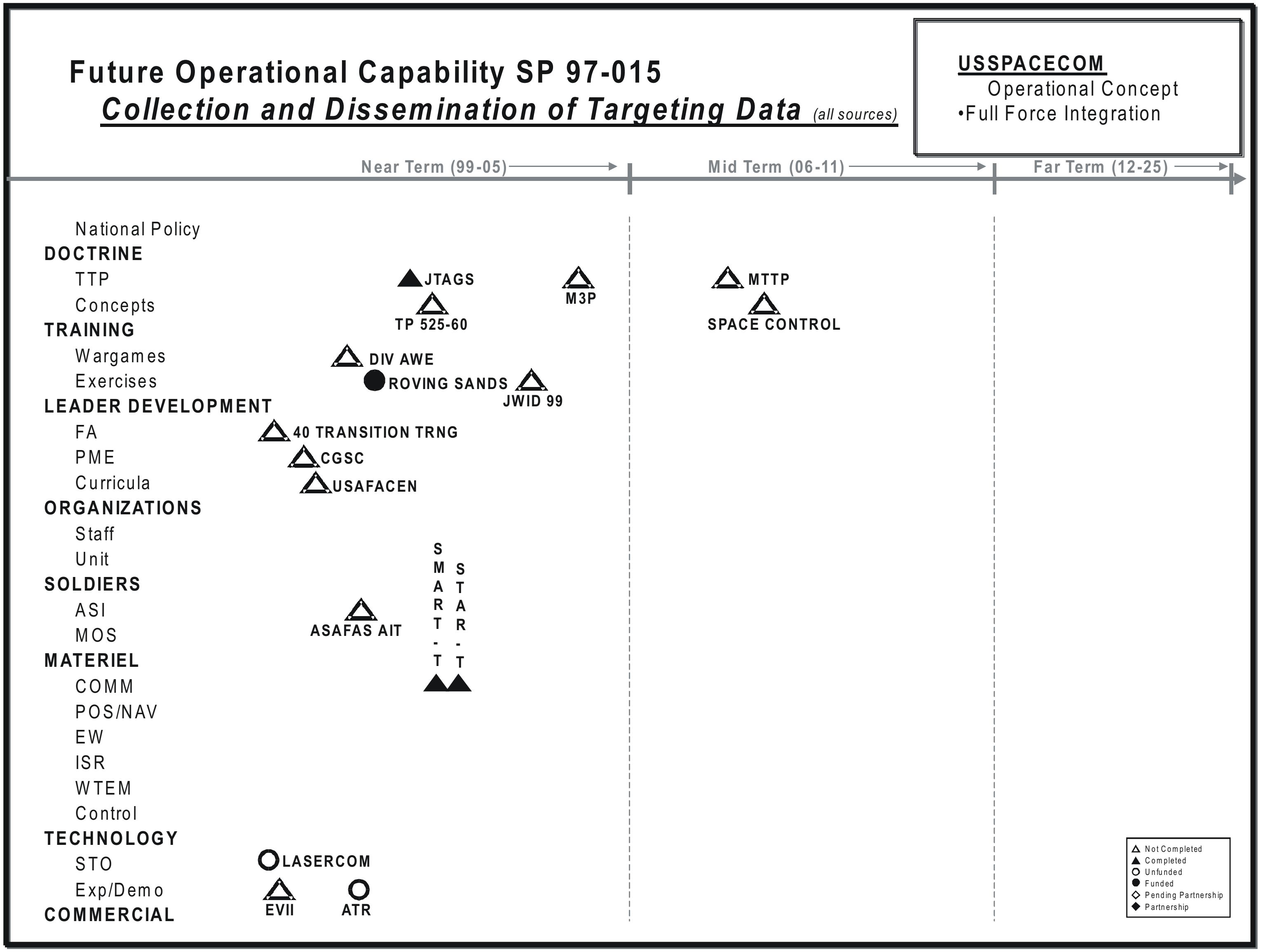
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Collection and Dissemination of Targeting Data (all sources)
USSPACECOM
Operational Concept
•Full Force Integration
Near Term (99-05)
Mid Term (06-11)
Far Term (12-25)
National Policy
DOCTRINE
TTP
Concepts
TRAINING
Wargames
Exercises
LEADER DEVELOPMENT
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COMMERCIAL
JTAGS
M3P
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TP 525-60
SPACE CONTROL
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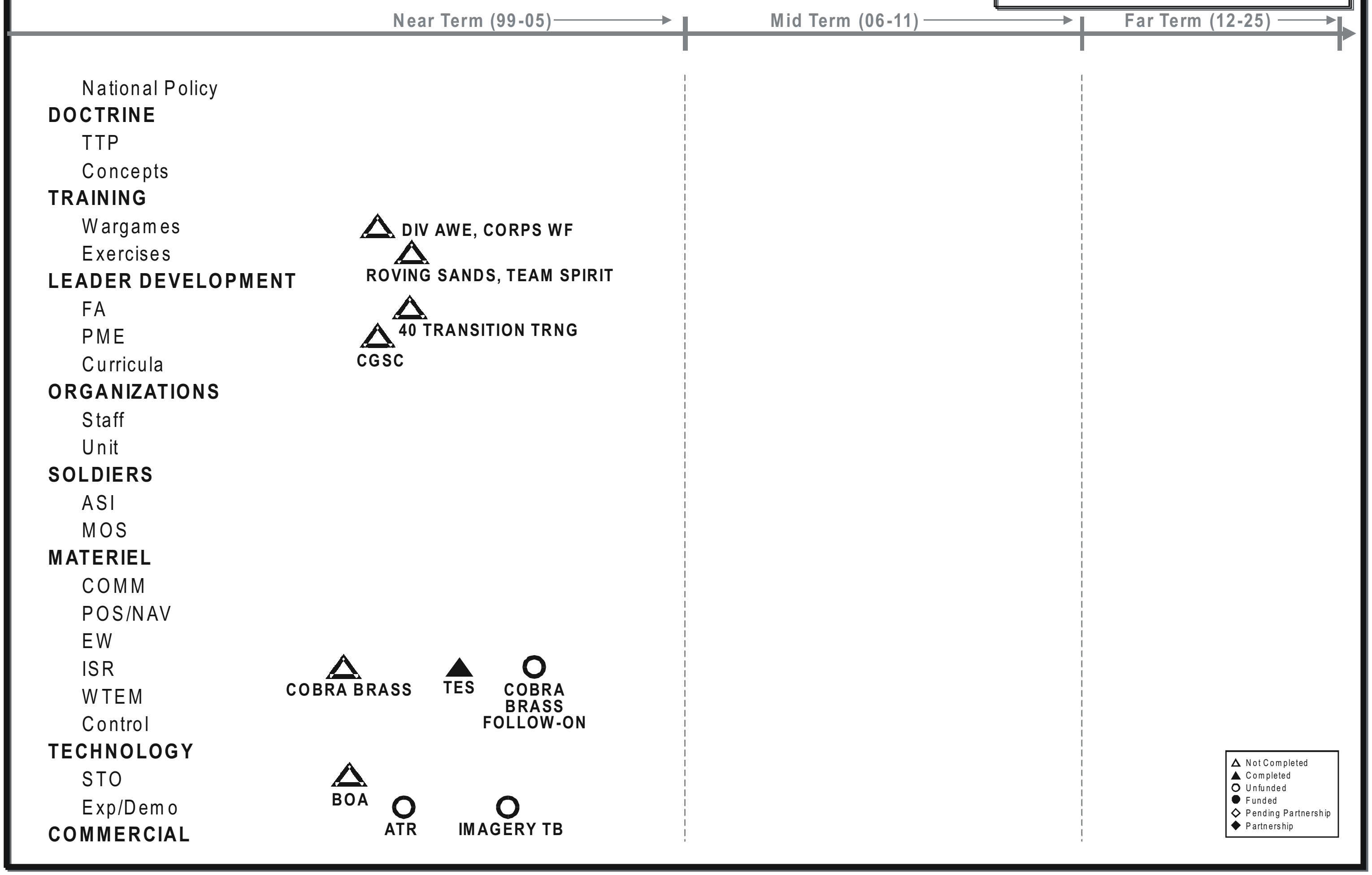
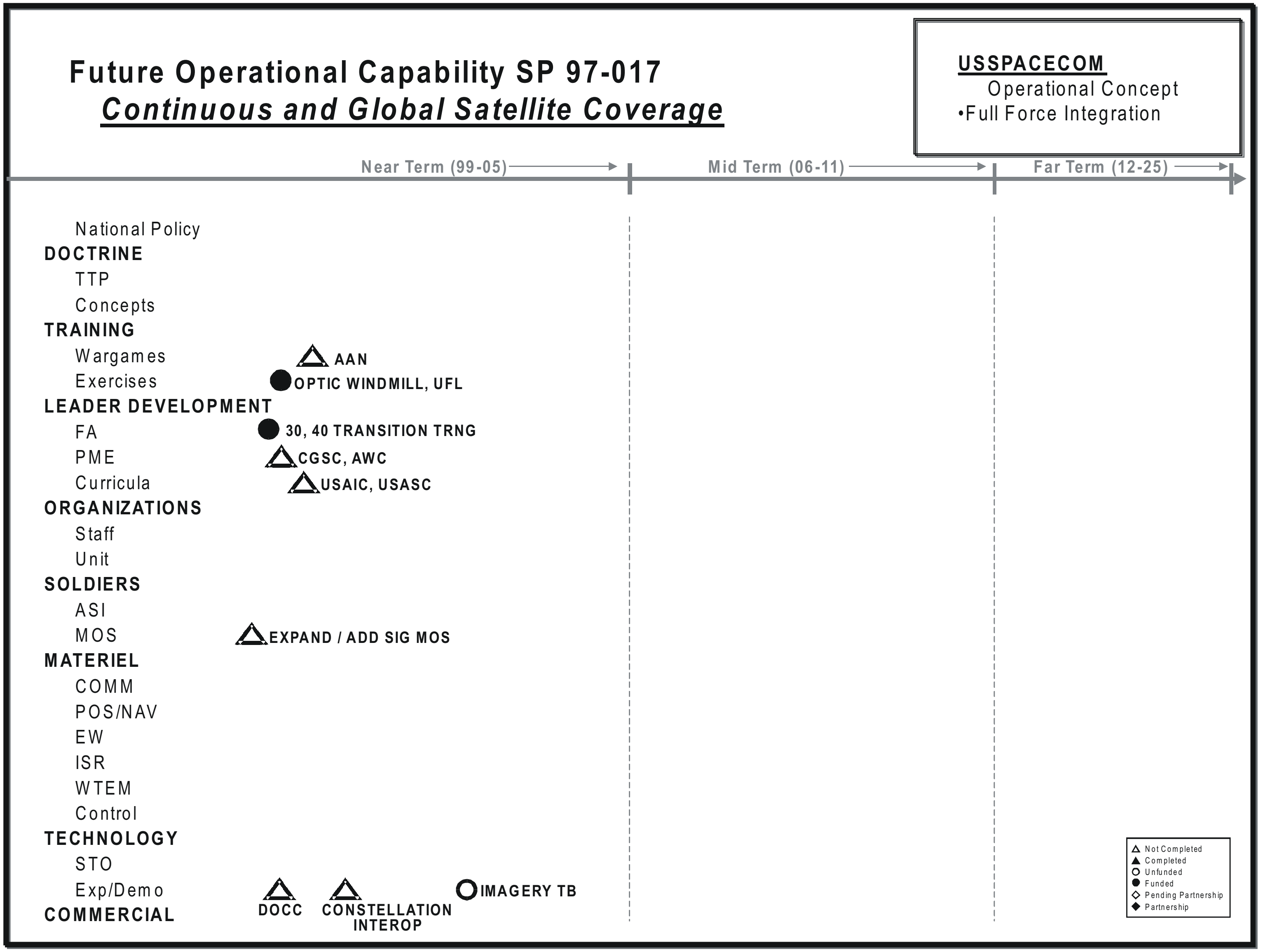
40 TRANSITION TRNG
CGSC
USAFACEN
SMART-T
STAR-T
ASAFAS AIT
LASERCOM
EVII
ATR
Not Completed
Completed
Unfunded
Funded
Pending Partnership
Partnership

Future Operational Capability SP 97-016
Automatic/Aided Target Recognition (ATR)

USSPACECOM
Operational Concept
•Full Force Integration

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Continuous and Global Satellite Coverage
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Operational Concept
•Full Force Integration
Near Term (99-05)
Mid Term (06-11)
Far Term (12-25)
National Policy
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30, 40 TRANSITION TRNG
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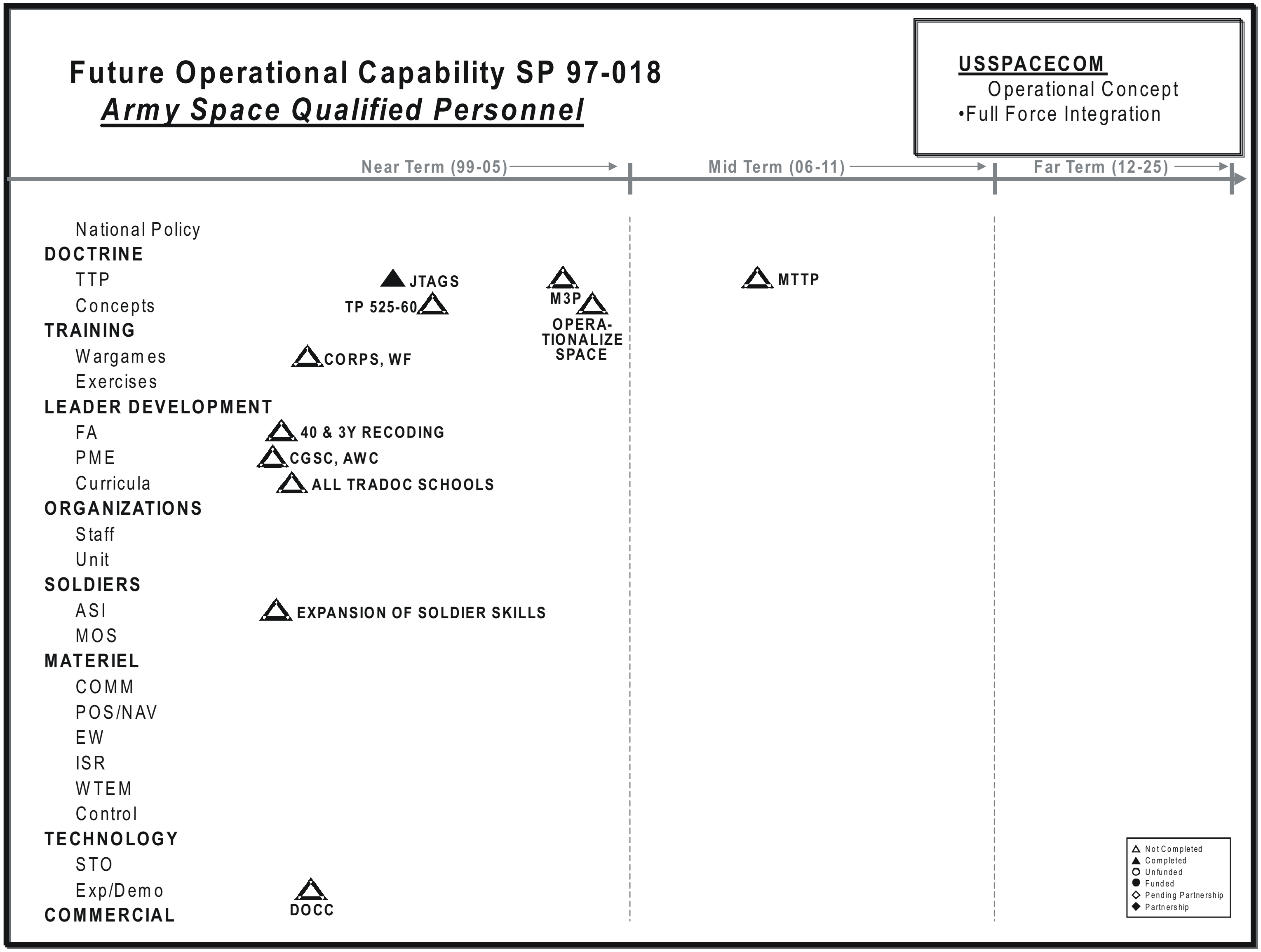
Unfunded
Funded
Pending Partnership
Partnership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Army Space Qualified Personnel
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Operational Concept
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Mid Term (06-11)
Far Term (12-25)
National Policy
DOCTRINE
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Concepts
TRAINING
Wargames
Exercises
LEADER DEVELOPMENT
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COMMERCIAL
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TP 525-60
M3P
OPERA-TIONALIZE SPACE
MTTP
CORPS, WF
40 & 3Y RECODING
CGSC, AWC
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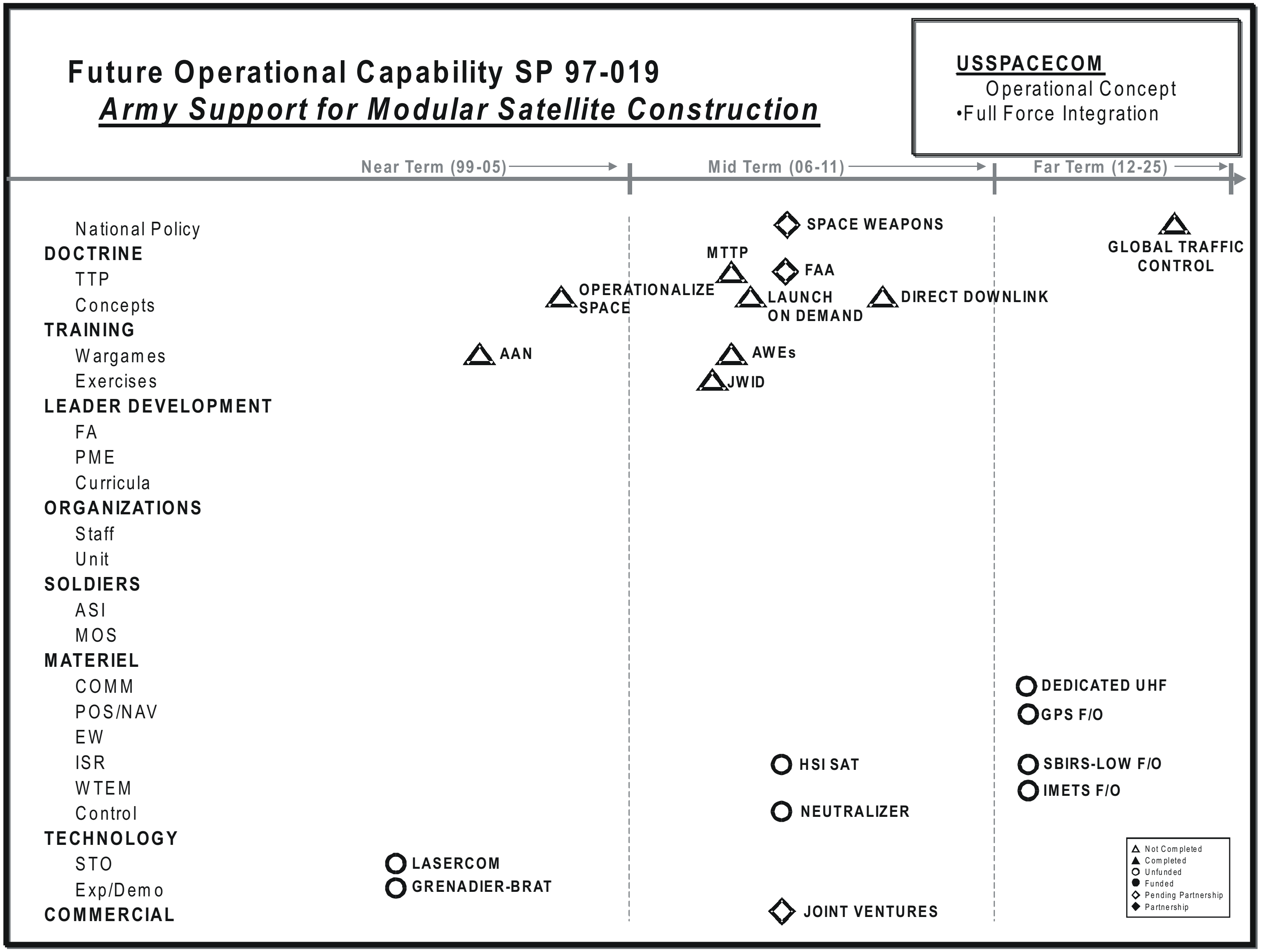
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Army Support for Modular Satellite Construction
USSPACECOM
Operational Concept
•Full Force Integration
Near Term (99-05)
Mid Term (06-11)
Far Term (12-25)
National Policy
DOCTRINE
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GLOBAL TRAFFIC CONTROL
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AAN
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HSI SAT
SBIRS-LOW F/O
IMETS F/O
NEUTRALIZER
LASERCOM
GRENADIER-BRAT
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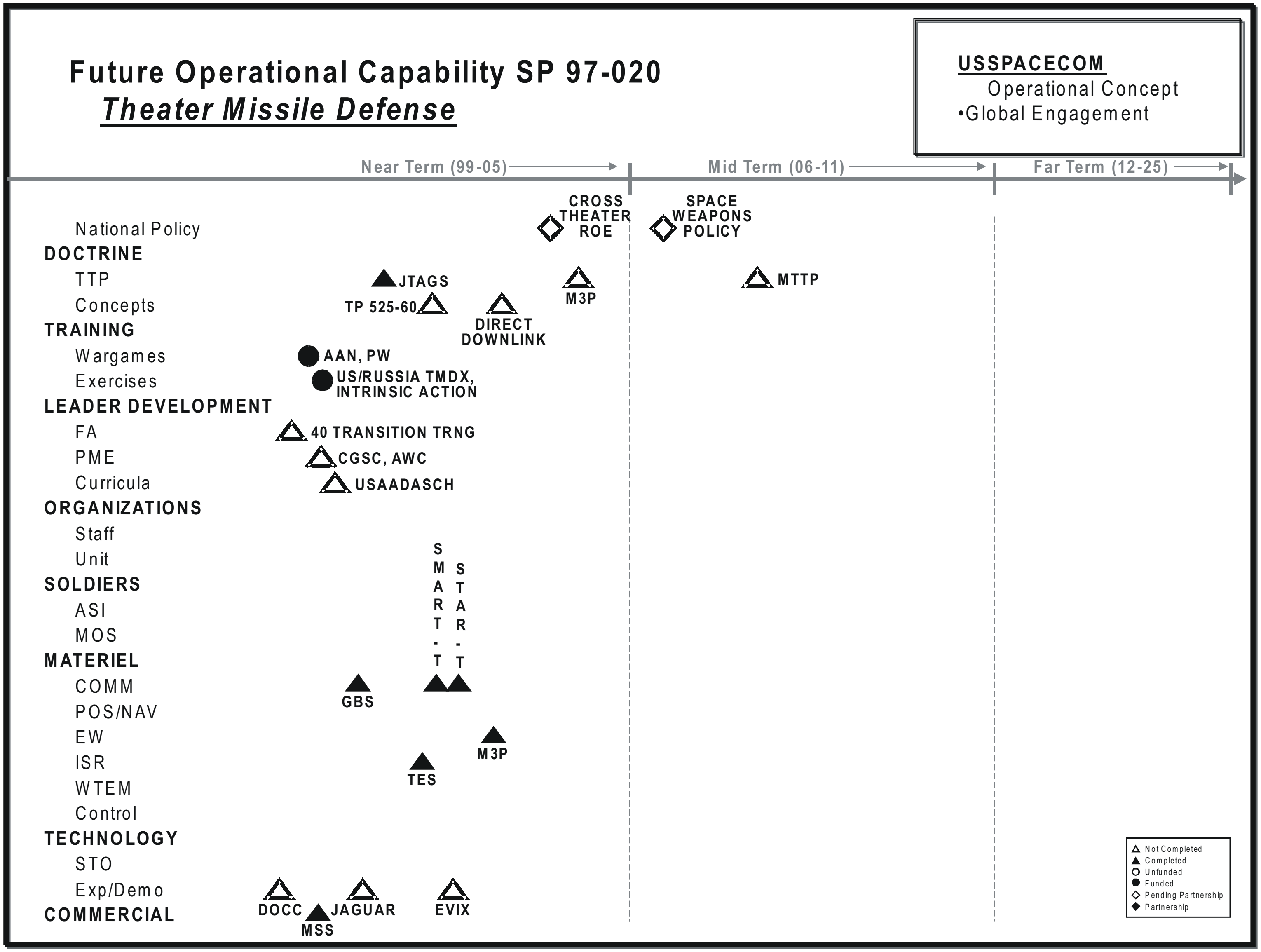
Partnership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Theater Missile Defense
USSPACECOM
Operational Concept
•Global Engagement
Near Term (99-05)
Mid Term (06-11)
Far Term (12-25)
National Policy
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AAN, PW
US/RUSSIA TMDX, INTRINSIC ACTION
40 TRANSITION TRNG
CGSC, AWC
USAADASCH
SMART-T
STAR-T
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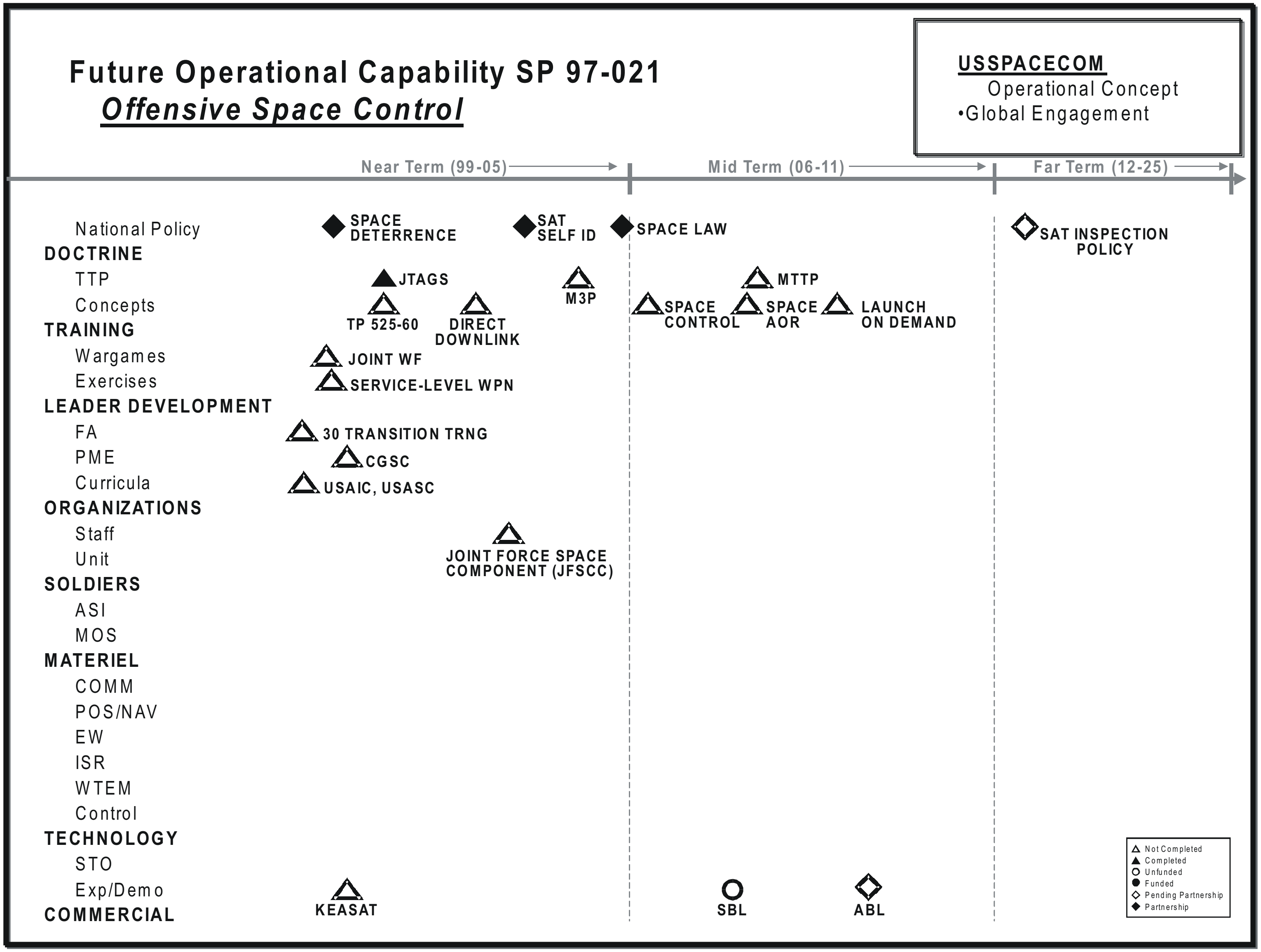

Future Operational Capability SP 97-021
Offensive Space Control
USSPACECOM
Operational Concept
•Global Engagement
Near Term (99-05)
Mid Term (06-11)
Far Term (12-25)
National Policy
DOCTRINE
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Concepts
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SPACE LAW
SAT INSPECTION POLICY
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M3P
MTTP
TP 525-60
DIRECT DOWNLINK
SPACE CONTROL
SPACE AOR
LAUNCH ON DEMAND
JOINT WF
SERVICE-LEVEL WPN
30 TRANSITION TRNG
CGSC
USAIC, USASC
JOINT FORCE SPACE COMPONENT (JFSCC)
KEASAT
SBL
ABL
Not Completed
Completed
Unfunded
Funded
Pending Partnership
Partnership

Annex D: Current and Near Term Systems

The following summaries provide an FY99 update on the status and plans for unclassified DoD Space Program elements that are of significance to the Army.

Communications

Satellite Communications represent the Army's single largest utilization of space assets. Information streams flow through satellites to provide for voice, data, and imagery. Historically, many ground terminals have been developed to fulfill different roles. A large part of the current modernization strategy is to minimize the number of different transceivers, emphasizing commonality, standardization and interoperability. Large fixed terminals are being modernized for operation at least through the year 2010. Older, relocatable systems with large dish antennae and large power supplies are being replaced with genuinely mobile transceivers. Channels are becoming more secure, data rates are being increased, and accessibility is being enhanced through increases in capacity and through technical means such as Demand Assigned Multiple Access (DAMA). This dramatically increases the load capacity of satellite channels for the Ultra High Frequency (UHF) satellite, a favorite with the warfighter due to its broad area coverage and foliage penetration.

It is beyond the scope of this document to describe all of the technical inter-agency and political characteristics of the various communication satellite types, frequency bands and allocations. The Army Satellite Communications (SATCOM) Architecture, the DOD Space Program documents and web site, the USSPACECOM Long Range Plan and the DOD Space Program Data Book for FY98/FY99 do an excellent job of providing these details. The Army SATCOM Architecture document also provides an overview of the process through which MILSATCOM support can be obtained by Army agencies.

At the end of calendar year 1998, there were over 200 active commercial communications satellites in orbit. In addition to these satellites, there are numerous military communications satellites (COMSATs) in operation. Although many of these commercial and military systems may be available in the future to support in-theater communication demands, this annex will only address six basic categories of U.S. systems expected to fill MILSATCOM needs in the near term. Table D-1 summarizes these six categories and their space and ground segments. Also included in the table is a column identifying the Army organizational levels at which the ground segment is expected to be most widely distributed.

Category	Space Segment	Ground/Control Segment	Echelon
Ultra High Frequency (UHF) (Mobile)	UHF Follow-On (UFO)	AN/PSC-3 & VSC-7 (phasing out) Being Replaced by AN/PSC-5 (SPITFIRE)	BN and Above
Super High Frequency (SHF) (Wideband)	Defense Satellite Communications System-III (DSCS-III) Gapfiller Advanced Wideband	AN/TSC-156 STAR-T/SOFTACs DISA-STEP RSCCE/ODOC (DSCS Comm Control) AN/GSC- 49 JRSC Universal Modem Army Terminal Upgrade (AN/FSC-78/79 & AN/GSC-39/52) TROJAN SPIRIT II	BN and Above ARSPACE BN and Above Fixed Sites EAC & Below
Extremely High Frequency (EHF) (Protected)	Milstar-I/II Advanced EHF	AN/PSC-11 SCAMP BLOCK I/II, single channel AN/TSC-154 SMART-T, multi-channel Command Post Terminal (CPT)	BN and Above BDE and Above CINC
Advanced MILSATCOM	Global Broadcast Service (GBS) Other		
National S-Band		Chariots S-Band Transceivers	
Commercial	Iridium INTELSAT PanAmSat Globalstar DOMSAT INMARSAT	Mobile Satellite Services (MSS) Military Individual Communicator (MIC) TROJAN SPIRIT	TBD EAC and Below

Table D-1: The Six Major Categories of MILSATCOM Systems

The dividing line between these satellite systems and the communication frequency bands they support is not as simple as Table D-1 implies. For example, the UFO satellites will also carry low data rate EHF transponders and a GBS transmitter, and DSCS III also carries one UHF Single Channel Transponder as part of the AFSATCOM Program. Commercial systems also vary in the frequencies used. For Army purposes, the commercial systems will be examined in terms of the services available, not how they relate to MILSATCOM systems.

An overview of the merits and limitations of each category will be addressed before examining the systems.

UHF

Ultra High Frequency systems are characterized by low bandwidth, limiting the number of simultaneous channels available. UHF can only support data transmission at low rates, making it vulnerable to interception. The area covered by a single UHF antenna system can be very broad, requiring less precision on the part of the ground segment in terms of pointing. This is attractive for mobile terminals, although it is becoming less important as self-aligning and stabilized pointing ground antennas become common. UHF is also the only waveband that can transmit or receive through significant foliage.

SHF

Super High Frequency wideband transceivers provide more usable bandwidth than UHF systems, resulting in more channels available for use. SHF also supports medium to high data rates transmission, which is essential to the rapid dissemination of imagery, weather maps, topographic data, etc. Some SHF anti-jamming (AJ) and low probability of intercept (LPI) protection is available. Coverage by SHF systems is considered regional as opposed to the broad area provided by UHF satellites.

EHF

Extremely High Frequency transceivers employ spread-spectrum frequency processing that provides a degree of protection from jamming. EHF also has anti-scintillation capabilities that help prevent communications dropout, lost data, and prevent lost contact. EHF also has low probability of intercept for secure messaging and data transmission.

GBS

The Global Broadcast Service will provide one-way communication to the warfighter, through military and commercial systems with multiple channels of information from CONUS injection up-link sites. GBS will provide: weather for selected sites of interest; theater imagery near-real-time; video broadcasts from high interest areas with current or near term action expectations such as airports, drop zones, and city streets; information on logistics, Air Tasking Orders; entertainment; and full time commercial news. The objective is to achieve inexpensive, broad area dissemination of information as rapidly as possible. GBS information should be considered "at risk" during intense conflict. In order to fully exploit the GBS media, the Army must work to develop an Information Dissemination Management (IDM) system to route GBS information. CECOM has the lead in FY99 efforts to create this IDM capability.

Commercial

Commercial communications organizations are responding to increasing demands for services in the marketplace with new capabilities. Hundreds of millions of dollars have been invested in new technologies to achieve state-of-the-art bandwidth utilization, maximum data rates and minimal dropouts. Now, and more so in the future, they offer the Army planner expanded channel access, medium and high data rates, and a choice of fixed, transportable, man-portable or manpackable (down to cell phone size) terminals for one-way and two-way communication. While transmissions from ground stations are typically not secure, some preventive measures can be implemented after satellite reception of the signal. Encryption at each end of the communication can easily be accommodated with supplemental Army equipment.

Many of these commercial systems are regional, but services such as INMARSAT and Iridium do provide worldwide coverage. Such service is billable directly to the requester, and currently costs several dollars per minute. However, all indications are that some mix of MILSATCOM and commercial capability will provide the Army with the required SATCOM of the future. The Commercial Satellite Communications Initiative (CSCI), mandated by Congress, requires the DoD to lease commercial capacity to support non-mission essential satellite communications. This mandate, coupled with associated budget pressure, ensures the Army may seek an optimum commercial-military mix. The terminal program associated with CSCI is the Commercial Satellite Terminal Program (CSTP) and is managed by PM MILSATCOM.

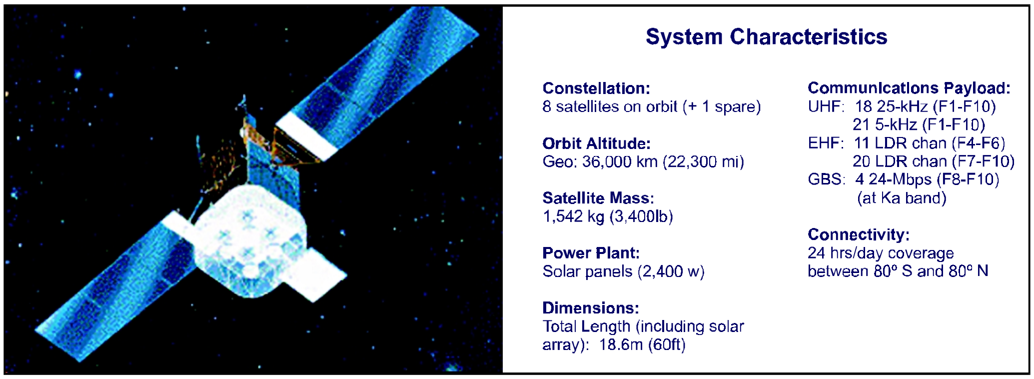


Figure D-1: UFO Satellite

UHF Space Segment

UHF services are being provided by the UHF Follow-On (UFO) system. Commercial COMSAT capabilities will increasingly be used to carry the fixed point-to-point communication load to allow increased military UHF support to mobile users. However, communication load projections for all services have shown that a "gapfiller" satellite will be required in the 2003-2004 timeframe in order to meet user demand until the next generation mobile user UHF system is available around 2007-2010. The Army must therefore provide defendable requirements to ensure that planning and design requirements meet its future needs.

Figure D-2: AN/PSC-5

UHF Ground Segment

The AN/PSC-5 "Spitfire" (formerly the Enhanced Manpack UHF Terminal [EMUT]) is a small, lightweight, single channel, UHF satellite transceiver that can be configured for manpack, vehicle, or airborne use and can provide voice and data communications. The radio operates in the 30-400 MHz range, and has embedded Communication Security (COMSEC) and Demand Assigned Multiple Access (DAMA). In addition to satellite relay communications, the Spitfire can operate line-of-sight. The AN/PSC-5 will be used primarily in the warfighter networks and will eventually replace the AN/PSC-3, AN/VSC-7, AN/MRC-140, AN/PSC-7, AN/PSC-10 and all other non-DAMA UHF ground terminals.

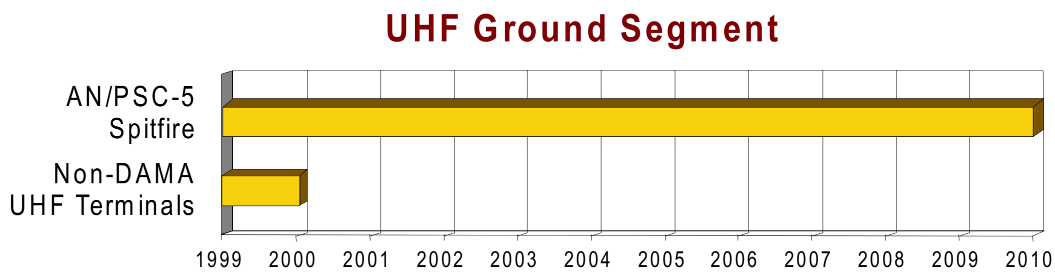
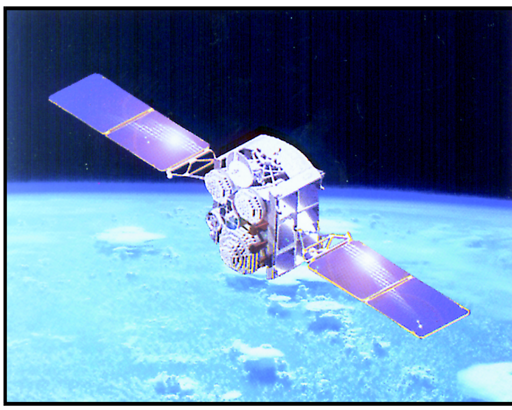


Table D-2: UHF Ground Segment Timeline

SHF Space Segment

The Defense Satellite Communication System III (DSCS III) is used by the National Command Authorities, Diplomatic Telecommunications Service, and White House Communications Agency, as well as the Service warfighters. Army Space Command operates DSCS ground stations, and at the request of the Army, the last four DSCS III satellites are being retrofitted under the Service Life Extension Program (SLEP) to provide increased power and transmitting capability to enhance support to small mobile terminals. As with UFO, demand projections for DSCS support in the 2003-2004 time period exceed expected capacity, resulting in the need for "gapfillers" until an Advanced Wideband System is available in 2008. As with UHF, Army communications requirements will be part of the decision and design process to ensure Army needs are met.



System Characteristics

Constellation:
5 satellites on orbit
(plus residual satellites)

Orbit Altitude:
Geo: 37,385 km (23,230 mi)

Satellite Mass:
Approx1,170 kg (2,580 lb)

Power Plant:
Solar panels (980 w)

Dimensions:
Total Length (including solar array): Approx 42.3 m (38 ft)

Frequency:
SHF X-band
7.9 - 8.4 GHz uplink
7.2 - 7.9 Ghz downlink

Communications Payload:
SHF: 6 transmitters with 50 - 85 MHz each
UHF: 1 AFSATCOM Single Channel Transponder (SCT) Transmitter

Connectivity:
24 hrs/day coverage between 80° S and 80° N

Figure D-3: DSCS III

SHF Ground Segment

The AN/TSC-156 SHF Tri-band Advanced Range-Extension Terminal (STAR-T) is a HMMWV mounted satellite terminal which can operate in conjunction with virtually any commercial or military satellite in the C, X, and Ku-bands. It will provide range extension for Tri-Service Tactical Communications (TRI-TAC) systems at Echelons Above Corps (EAC) and selected Echelons Corps and Below (ECB) units.

Figure D-4: AN/TSC-156 STAR-T

The terminal operates with a crew of three, and sets up in 30 minutes. STAR-T will replace all AN/TSC-85B and AN/TSC-93B satellite terminals at EAC and provide TROJAN SPIRIT II communications support at EAC.

The Defense Information Systems Agency (DISA) Standardized Tactical Entry Point (STEP) program is an initiative to upgrade 14 of the DSCS entry points with a standard set of core Command, Control, Communications, Computers, and Intelligence (C^4I) services and equipment to improve support for tactical forces. STEP terminals are the link between the tactical DSCS terminals and the Defense Satellite Communications System. The Ground Mobile Forces (GMF) STEP terminals have large antennas and high powered electronics that allow them to receive low power level tactical transmissions, and amplify them for worldwide relay.

The Jam Resistant Secure Communications (JRSC) network is an add-on capability to DSCS terminals (AN/GSC-49, AN/FSC-78, AN/GSC-52) initially intended to improve Worldwide Military Command and Control System's (WWMCCS) capability for jam resistant secure communications via satellite. JRSC consists of SHF satellite terminals packaged to satisfy JRSC requirements that will survive jamming and high altitude nuclear events that cause High-Altitude Electromagnetic Pulse (HEMP) atmospheric conditions. Plans are to transition the JRSC network to Milstar in 2003.

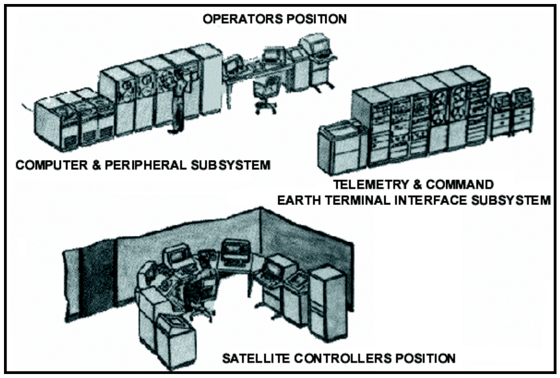


Figure D-5: RSCCE

The DSCS Replacement Satellite Configuration Control Element (RSCCE) is a replacement for the aging Production Satellite Configuration Control Element (PSCCE) which controls the communication payload on DSCS III satellites. The RSCCE will be installed in fixed site DSCS Operation Centers (DSCSOCs).

The Universal Modem System (UMS) is a multi-national program that will allow allied strategic and tactical forces to have interoperable voice and data communications under jamming and scintillation conditions when using the DSCS III, NATO, or SKYNET 4 satellite systems. The UMS will be integrated into the STAR-T terminal and the System Planning Computer located in DSCSOCs.

Army Terminal Upgrade and Replacement. A program is in place for the modification of equipment to upgrade the AN/FSC-78/79 Heavy Terminal and the AN/GSC-39/52 Medium Terminal satellite Earth terminals. This program will permit all DSCS strategic Earth terminals to use common electronics and logistics support.

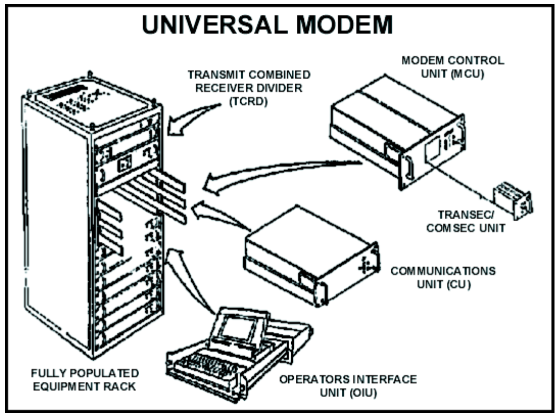


Figure D-6: Universal Modem System

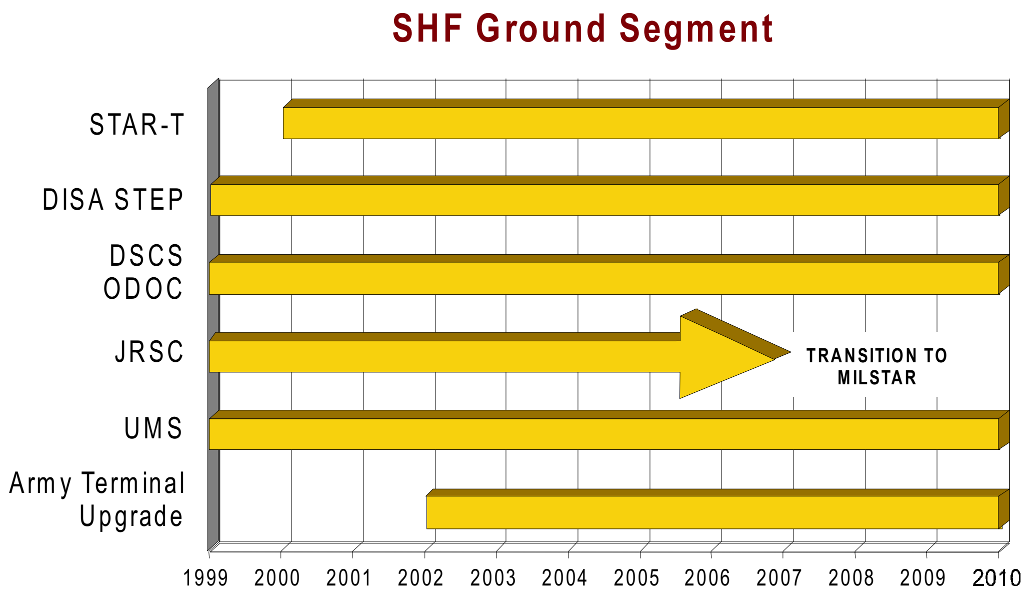


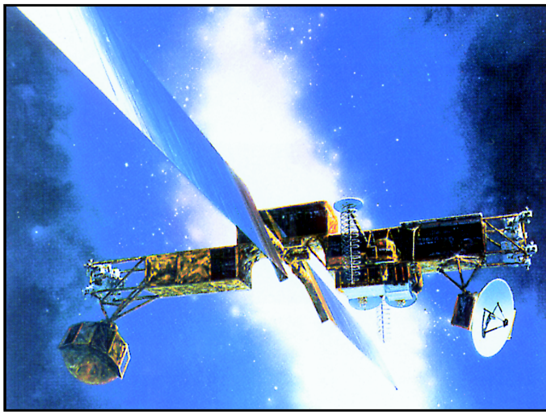
Table D-3: MILSATCOM SHF Ground Segment Timeline

EHF Space Segment

Milstar I and II satellites are uniquely military and offer jam-resistant, low probability of detection or intercept, nuclear hardening and anti-scintillation. Two Milstar I satellites are currently on orbit. The first Milstar II is scheduled for launch in FY99. A total of four Milstar IIs are programmed to complete the Milstar system. Increased capacity needs are anticipated and an advanced EHF satellite is planned for the 06-07 time frame. Army requirements for the unique support offered by Milstar must be clearly written to ensure tactical needs are met.

EHF Ground Segment

The AN/PSC-11 **Single Channel Anti-jam Man Portable (SCAMP)** terminal is an EHF transceiver designed to operate with the Milstar low data rate payload. It can also operate with the EHF channels on FLTSAT and UFO. The terminal will operate in point-to-point,



System Characteristics

Constellation:
6 satellites on orbit
2 Milstar I and 4 Milstar II
2 Milstar I on orbit now

Orbit Altitude:
Geo: 36,000 km (22,300 mi)

Satellite Mass:
Approx 4,536 kg (10,000 lb)

Power Plant:
Solar panels (5,000 w)

Dimensions:
Body Length: 15.5m (51 ft)
Total Length (including solar array): 42.3m (116 ft)

EHF/SHF Services:
EHF: 44.5 GHz uplink
SHF: 20.7 GHz downlink

Communications Payload:
LDR: 192 channels of 75-2,400 bps
MDR: 32 channels at 4.8 kbps - 1.544 Mbps

Connectivity:
24 hrs/day coverage between 65° S and 65° N
Inter-satellite crosslinks, one in each direction (east and west)

Figure D-7: Milstar

broadcast, and netted voice modes. SCAMP will provide voice and data service at a data rate of 2400 bps in a non-jamming environment, degrading to 75 bps in its anti-jam configuration. The program is divided into Block I and II versions. SCAMP Block I is manportable (37 pounds), and will be used for command and control communications between headquarters elements and subordinate commands. SCAMP II is manpackable (15 pounds) and provides point-to-point and radio range extension for conventional and special operations forces. Setup time is 10 minutes. It is interoperable with all Milstar terminals, and has embedded COMSEC and GPS capabilities. SCAMP can communicate with SMART-T through the low data rate port.

The AN/TSC-154 **Secure Mobile Anti-jam Reliable Tactical Terminal (SMART-T)** is a mobile, multi-channel, tactical satellite communications terminal that operates with the Milstar satellite EHF payload. It provides the user with secure, survivable, anti-jam, satellite communications. It will process data and voice communications at LDR and MDR from 75 bps to 1.544 MBps with a total

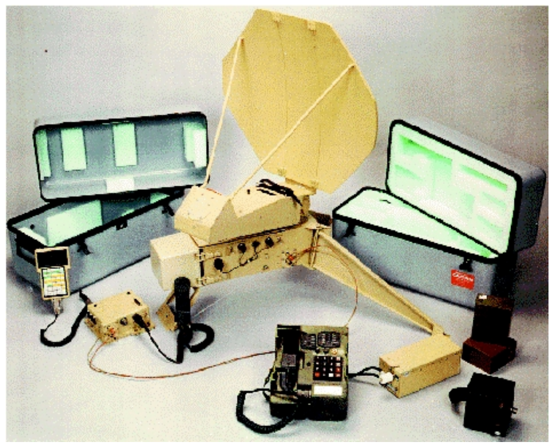


Figure D-8: AN/PSC-11 SCAMP

aggregate up to 2.240 MBps. SMART-T can be operated remotely and will support four LDR and twelve MDR ports. The terminal will be mounted on a HMMWV and has a setup time of 30 minutes. SMART-T will replace all SHF AN/TSC-85 and AN/TSC-93 GMF terminals now in use at ECB. Once replaced, the GMF terminals will be moved to support operations at EAC.

The AN/TRC-194 Milstar Command Post Terminal (CPT) is a transportable system designed to provide secure, jam-resistant voice, data and teletype communications to both tactical

Figure D-9: AN/TSC-154 SMART-T

and strategic commanders. The terminal can transmit 8 channels, receive on 16 channels, and operate at a LDR of 75 bps-2.4 kbps data and voice. The CPT is compatible with EHF, UHF and SHF band capabilities in development for Milstar. The system is operated by a 6 person crew, transported by two 5 ton trucks, operates with an 8 foot parabolic antenna, and can be setup in two hours. The CPT supports CINC Milstar networks, and provides a means to pass emergency action and force direction messages, as well as Integrated Tactical Warning/Attack Assessment (ITW/AA) through a jamming environment and the effects of High altitude Electro-Magnetic Pulse attack. Current plans are to field six of these terminals.

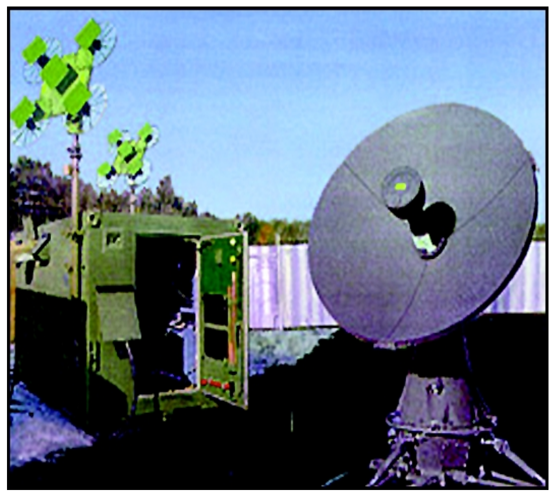


Figure D-10: AN/TRC-194 Milstar Command Post Terminal

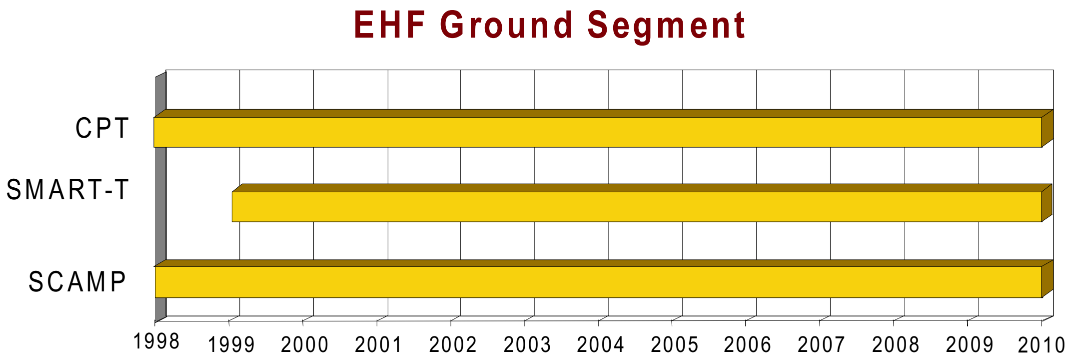


Table D-4: EHF Ground Segment Timeline

Advanced MILSATCOM Space Segment

This category of MILSATCOM Systems Space Segment has a much more generic definition than the previous five. It includes a mixture of military and commercial satellite systems employed to support specific applications. The best example is the Global Broadcast Service (GBS). There are no dedicated GBS satellites. Instead, the system will use "ride-along" capabilities on military satellites and purchase capacity on commercial satellites. Descriptions of current activities in Advanced MILSATCOM can be obtained from the PM MILSATCOM office.

Advanced MILSATCOM Ground Segment

The **Ground Receive Terminal (GRT)** provides the warfighter with a means to receive high data rate imagery, video, data files and other information over the Global Broadcast Service. The GRT consists of a satellite antenna, receiver/decoder, and computer that packs into 6-9 transit cases. GRTs will be fielded to tactical combat arms, combat support, and combat service support units to battalion level.

The **MILSATCOM Individual Communicator (MIC)** is a new start Army program intended to provide worldwide information transfer using the Iridium commercial satellite system. Funding for the MIC program will begin in FY00.

The **Multiband Integrated Satellite Terminal (MIST)** is a new Army program intended to provide advanced satellite communications in multiple bands. Funding for the MIST program will begin in FY04.

Transit Medium Data Rate (TRAM) is an Army program intended to provide advanced satellite communications capabilities for high throughput information transfer. Funding for the TRAM program will begin in FY02.

Commercial Space Segment

Iridium is a constellation of 66 low Earth orbiting satellites that provide commercial voice, data, paging, facsimile,

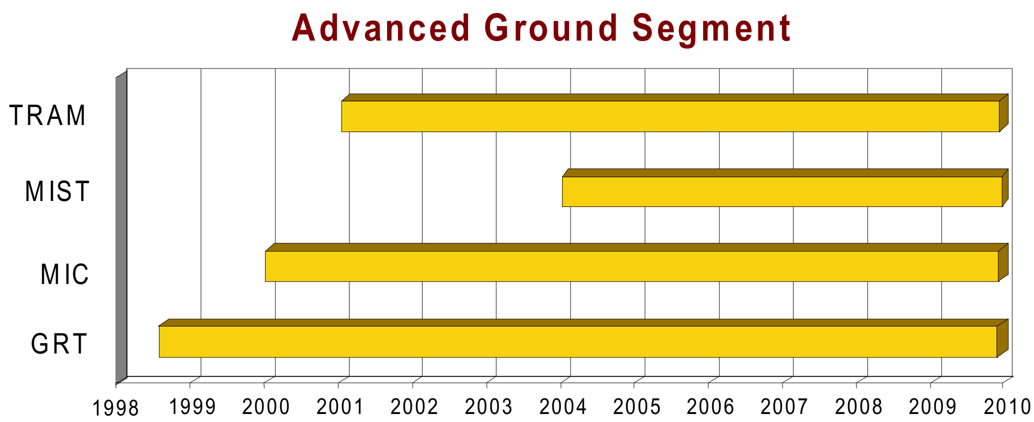


Table D-5: Advanced MILSATCOM Ground Segment Timeline

and messaging services. The system is owned and operated by Iridium LLC, a global consortium of telecommunications and industrial companies. Iridium ground terminals and satellites are built by Motorola, Inc. The first Iridium satellite was launched in December 1996, and the company began offering operational commercial service in November 1998.

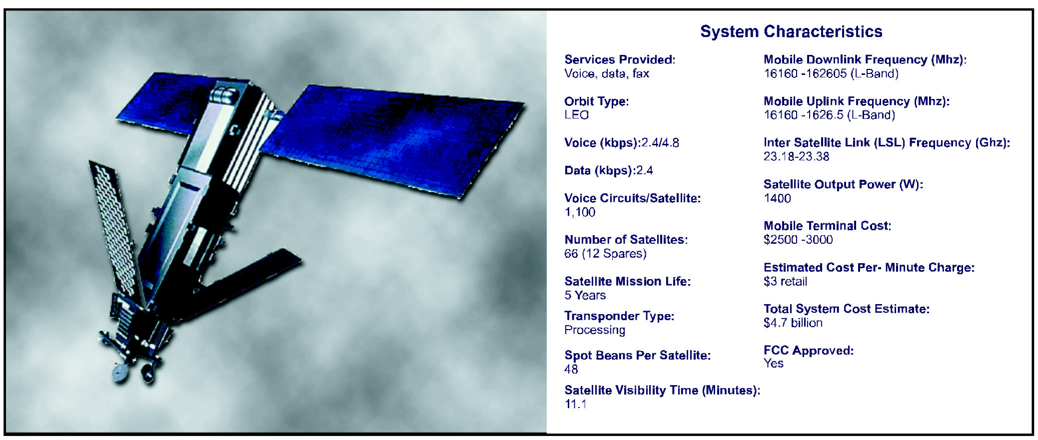
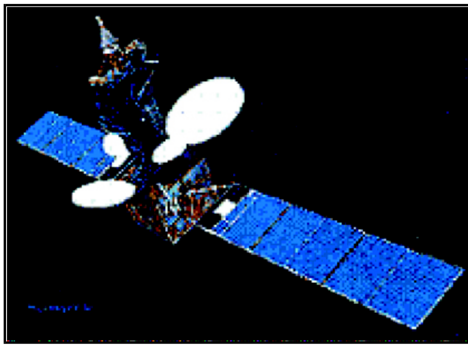


Figure D-11: Iridium

The International Telecommunications Satellite Organization (INTELSAT) is the world's largest commercial satellite communications services provider. It is an international consortium that owns and manages a constellation of communications satellites to provide international broadcast services. Ownership and investment in INTELSAT (measured in shares) is distributed among INTELSAT members according to their respective use of services. Investment shares determine each member's percentage of the total contribution needed to finance capital expenditures.

Spacecraft operations are controlled through ground stations in Italy, China, Germany, Australia, and the



Specifications

Spacecraft: 3 axis stabilized to 0.5 deg using momentum wheels. Hydrazine propulsion system. Passive thermal control. Dual solar arrays provide 1800 W BOL. NiCd or NiH batteries.

Payload: 21 C-band and 4-Ku-band transponders. 12000 voice circuits and 2 TV channels.

Country of Origin: International

Customer/User: INTELSAT Inmarsat

Manufacturer(s): Ford Aerospace

Figure D-12: INTELSAT

United States. Additional commercial SATCOM suppliers being considered by the Army are the PanAmSat and Globalstar networks.

PanAmSat is a global system of satellites and ground facilities that provide the following services worldwide:

- The distribution of cable and broadcast television channels;
- Private communications networks using rooftop or similar antennas; and
- New services such as international Internet access.

PanAmSat can support secure low data rate transmissions and television broadcasts.

The Globalstar system provides voice, data, fax, and other telecommunications services worldwide. Users of Globalstar make or receive calls using hand-held or vehicle mounted terminals similar to today's cellular phones. Calls are relayed through the Globalstar satellite constellation to a ground station, and then through local terrestrial wireline and wireless systems to their end destinations. Globalstar can support low data rate transmissions where appropriate ground stations are available.

Specifications

Spacecraft: 3 axis stabilized using momentum bias system. Bipropellant propulsion system. Dual solar arrays and nickel-hydrogen batteries.

Payload: Transponders: 14 C-band channels at 50 Watts and 30 Ku-band channels at 100 Watts.

Country of Orgin: United States

Customer/User: PanAmSat's international customers

Manufacturer(s): Space Systems/Loral

Figure D-13: PanAmSat

Commercial Ground Segment

The Mobile Satellite Services (MSS) program modifies and installs a government owned commercial gateway to provide personal communications services. This gateway will allow access to commercial satellite constellations, and provide worldwide voice, data, fax, paging, and location tracking services to handset users. Motorola will provide an Iridium Gateway, user terminals/handsets, and Iridium service. Early in FY01 Loral will deliver a deployable Globalstar Gateway, terminals/handsets, and Globalstar service. Use of these services is expected to continue to 2010.

Figure D-14: AN/TSQ-190, TROJAN SPIRIT II

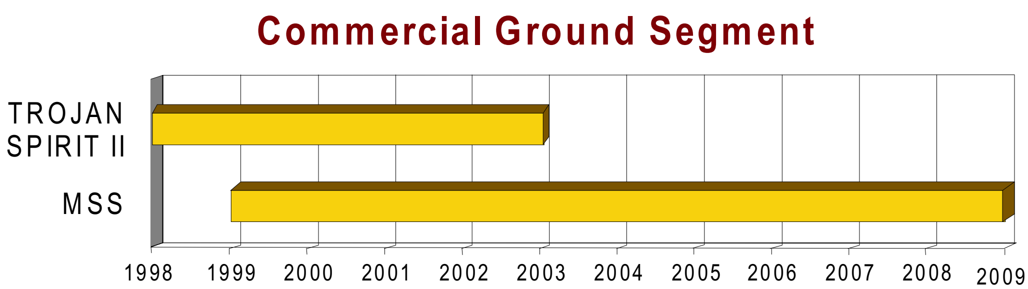


Table D-6: Commercial MILSATCOM Ground Segment Timeline

FOCs Supported:

- SP 97-001 Space Sensors Linked with Terrestrial Systems
- SP 97-002 Passive and Active Target Detection and Processing
- SP 97-004 Support Battle Damage Assessment
- SP 97-009 Real Time Prioritized Information Dissemination
- SP 97-014 Collection and Dissemination of Mapping, Charting, and Geodesy (MCG)
- SP 97-020 Theater Missile Defense

The TROJAN Special Purpose Integrated Remote Intelligence Terminal (SPIRIT) II, AN/TSQ-190 provides Army tactical commanders with high capacity near real time access to intelligence from TROJAN Classic sites, national agencies, and other tactically deployed units using UHF and SHF military, and C/Ku commercial band satellites. It will operate with INTELSAT, PanAmSat, Globalstar, DOMSAT and DSCS. TROJAN SPIRIT II is intended to provide an interim SATCOM capability until the fielding of the STAR-T.

Reconnaissance, Intelligence, Surveillance, and Target Acquisition (RISTA) Space Segment

Space support to the RISTA requirements of the Army represents the area of greatest potential for future growth and impact to operational patterns. The National Reconnaissance Office (NRO) provides RISTA collection support to all government agencies through various national assets. The information available from these sources is provided by the intelligence community to Army commanders through systems provided by the Army Space Program Office (ASPO) under the Tactical Exploitation of National Capabilities (TENCAP) program, which serve as preprocessors for the All Source Analysis System. The specific capabilities of the national space segments supporting RISTA are classified. General collection capabilities of these systems however, include IMINT, SIGINT and MASINT. Communications satellites discussed in the previous section may be used to transfer the RISTA information into theater for access by the various ground segments. Commercial and civil space initiatives are being demonstrated and developed which may be capable of supplying RISTA information to the warfighter through direct injection to theater receivers. All of these fall into the category of programs covered in Chapter 6.

Reconnaissance, Intelligence, Surveillance, and Target Acquisition (RISTA) Ground Segment

The All Source Analysis System (ASAS) is a mobile, automated intelligence processing, fusion, and dissemination system designed to provide timely, accurate and relevant all source

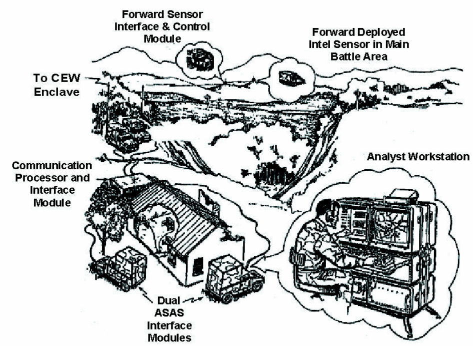


Figure D-15: All Source Analysis System

intelligence and targeting support down to battalion level, to give commanders the information needed to understand enemy capabilities and intentions. At national and tactical level ASAS receives and correlates information to produce a common picture of the ground situation. The system also assists intelligence managers in rapidly disseminating intelligence information, nominating targets, and managing Intelligence and Electronic Warfare (IEW) assets.

Army Tactical Exploitation of National Capabilities (TENCAP) Program

The Army TENCAP Program is executed by the Army Space Program Office (ASPO), an agency under the Acquisition Center of the Space and Missile Defense Command. Army TENCAP is not strictly about information derived from space-based systems. The focus is on all sources of information important to the warfighter, both in the planning and execution stages. Such sources could include UAVs (Global

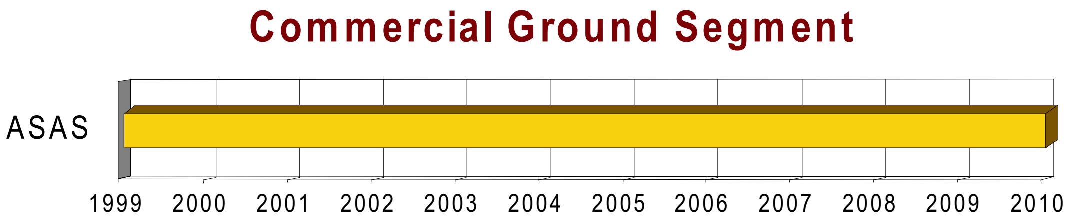


Table D-7: RISTA Ground Segment Timeline

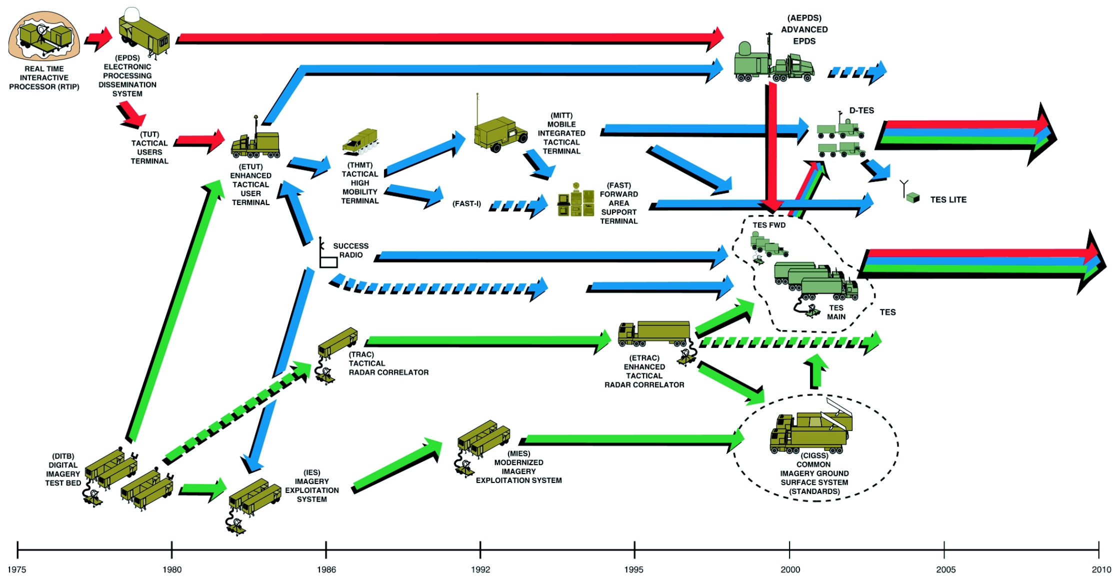


Figure D-16: TENCAP Objective Architecture for 2003

Hawk, Dark Star, Predator), fixed wing aircraft (Rivet Joint, ATARS, etc.) and other collection sources which would all be integrated into a common picture when combined with satellite-based collections.

The overarching objectives for evolution of TENCAP systems is to reduce ground segment size and weight, increase modularity, commonality, and information throughput enhancing responsiveness to the warfighter. Figure D-19 presents the objective architecture for 2003 based on migrating functions to the Tactical Exploitation System (TES). The TES architecture enhances overall capability while simplifying interfaces. The continuing emphasis for Army TENCAP will be on increased quality and quantity of data to the commander with reduced latency, and development of practical sensor-to-shooter linkages.

Tactical Exploitation of National Capability (TENCAP) Ground Segment

The **Modernized Imagery Exploitation Systems (MIES)** is a Corps and EAC tactical imagery exploitation system capable of receiving, processing, and exploiting national and selected theater imagery. The system provides first phase imagery exploitation for the indications and warnings missions of Army users. It provides Imagery

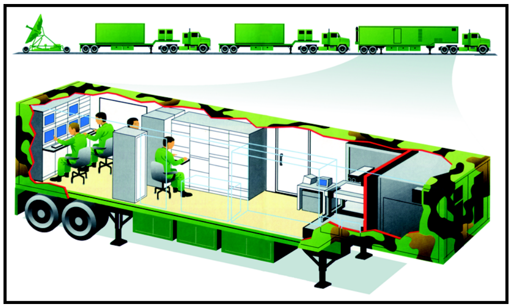


Figure D-17: MIES

Intelligence (IMINT) reports and Secondary Imagery Dissemination (SID) through an extensive communications section. It travels with its own SATCOM system that provides the relayed national imagery through the Defense Dissemination System (DDS). The MIES consists of three primary operational vans: a SATCOM van, a national segment van, and an exploitation van. Accompanied by its organic support equipment, the system can be deployed worldwide and operate without local support resources. MIES will be phased out as the TES is fielded.

The mission of the **Enhanced Tactical Radar Correlator (ETRAC)** is to provide the Army field commander with accurate, reliable, and timely imagery-based battlefield intelligence derived from the Advanced Synthetic Aperture Radar System-2 (ASARS-2) carried aboard the U-2 aircraft. It can also receive and exploit imagery from the Predator UAV and interfaces are planned for the Global Hawk and Dark Star UAVs. It is capable of disseminating intelligence data to the ASAS via area communications networks and can exchange data with other Intelligence, Surveillance, and Reconnaissance (ISR) ground stations.

Figure D-18: ETRAC

Imagery intelligence is disseminated to support units in the form of annotated imagery, text report/messages, or voice reports. The system provides ASARS imagery to MIES for exploitation as well as situation and target development. As a part of its Block II upgrade in FY98, ETRAC will incorporate an automatic target cueing capability.

The **Advanced Electronic Processing and Dissemination System (AEPDS)** receives and processes raw data from selected national sensors, stores processed data, and produces intelligence reports in support of Corps and selected EAC. Additionally, AEPDS receives, processes, and disseminates other selected intelligence reports and imagery products. The system supports close, deep, rear, and special operations by providing the ability to see deep into the battle area and by providing targeting, terrain, ingress, and egress information. The AEPDS configuration was achieved by upgrading existing Enhanced Tactical User's Terminal (ETUT) systems with the Miniaturized Data Acquisition System (MIDAS), D-band capability, and EPDS software functions. The AEPDS interfaces with current intelligence and electronic warfare processing and dissemination systems, including the ASAS.

Figure D-19: AEPDS

The **Mobile Integrated Tactical Terminal (MITT)** is a brigade, division and corps level mobile, transportable system capable of providing multiple-source Signal Intelligence (SIGINT) and Imagery Intelligence (IMINT) to Army tactical forces. It provides timely integrated intelligence products in response to the tactical commander's requirements; receives, annotates, and transmits secondary imagery; receives, processes, and disseminated SIGINT data; and maintains a correlated data base. The MITT has a robust communications suite including S-band, and UHF SATCOM, UHF LOS RADIO, MSE, AUTODIN, and STU III.

Figure D-20: MITT

The **Forward Area Support Terminal (FAST)** was developed to provide a downsized functional equivalent of the MITT, and provide those capabilities in a modular/soldier-portable system. The system consists of a self-contained RF subsystem, a processing subsystem, and a communication subsystem. The integration of these subsystems allows multi-source receipt, transmission, and analysis of a wide range of products.

Figure D-21: FAST

The **Tri-band SATCOM Subsystem (TSS)** is a communication suite of equipment designed for use with the MIES TENCAP system. The terminal permits operation with military or commercial satellites in the C, X, and Ku bands.

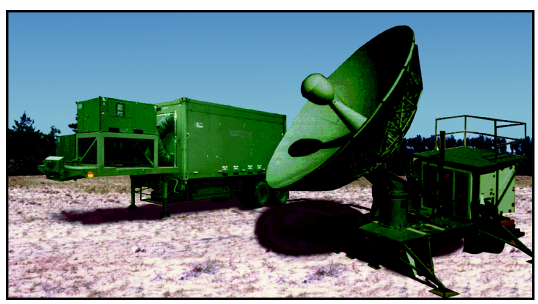


Figure D-22: TSS

Chariot is a tactical S-band SATCOM terminal that can receive signals from HEO, GEO, and LEO satellites. It is designed to support the Army's tactical mission by receiving, and disseminating intelligence data obtained from national sources. Its small size and light weight provide a rapid deployment communications capability that is typically deployed with FAST and MITT.

Figure D-23: Chariot

The **TENCAP Guard** provides DIA accredited interface for secure network capability with access to the Mobile Subscriber Equipment (MSE) Tactical Packet Network (TPN) and the DSNET1/SIPRNET. It provides a secure release mechanism to facilitate sending and receiving e-mail, bulk file transfers, and imagery from TENCAP systems to collateral systems across collateral tactical and strategic packet networks. Guard is integrated into FAST, MITT, AEPDS, and MIES.

The **Synthesized UHF Computer Controlled Equipment Sub-system (SUCCESS)** is a UHF line of sight and SATCOM transceiver that can simultaneously receive on three channels and transmit on one channel. Its built-in broadcast incorporates JCS mandated Demand Assigned Multiple Access (DAMA) capability. SUCCESS is fielded in AEPDS, MIES, ETRAC, MITT, and FAST.

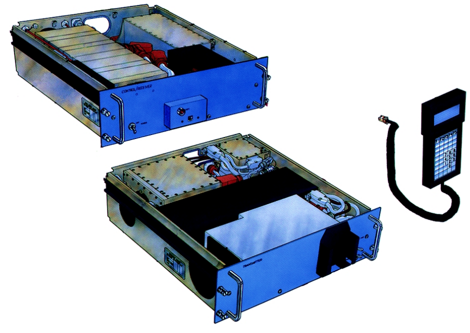


Figure D-24: Success

The **Communication Systems Processor (CSP)** performs message processing, and is installed in all Army TENCAP systems. Originally developed and fielded in 1981, the processor can operate as the front end message processor for host workstations, or in stand-alone message centers. It supports automatic or manual message processing, and can handle a throughput rate greater than 1000 messages per hour. The CSP is TENCAP's turn-key solution to record traffic processing requirements.

Figure D-25: CSP

The **National Imagery Transmission Format Standard (NITFS) Communication Interface Unit (NCIU)** provides the capability to communicate with other NITFS-compatible SID systems by way of the Tactical Communications Protocol, version 2 (TACO2). The NITFS-specified TACO2 protocol is implemented in the NCIU. The NCIU supports both the NITFS synchronous High-level Data link Control (HDLC) and asynchronous Serial Line Internet Protocol (SLIP) data layer protocols. The NCIU is NITFS compatible using the TACO2 protocol in full duplex, half duplex, and simplex modes. The NCIU is integrated into MIES, AEPDS, ETRAC, MITT, and FAST.

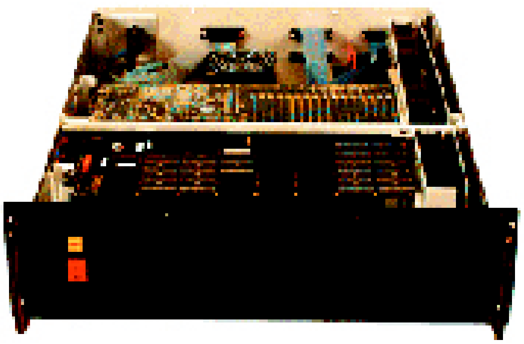


Figure D-26: NCIU

The **Interactive Training Tool (ITT)** is a computer-based tool designed for formal classroom or exportable, self-paced, on-the-job training of imagery analysts. The ITT is a UNIX based software package that can be installed as an application on a user's workstation or site LAN. The software can run on a variety of Sun or Silicon Graphics workstations and under several operating systems. Users have access to a wide variety of course material, as well as the ability to create their own training material.

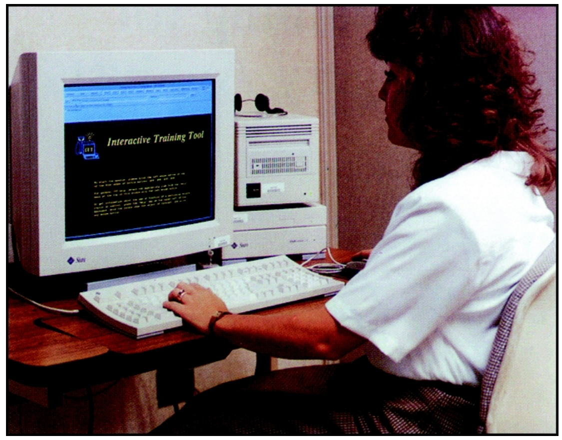


Figure D-27: ITT

The **Tactical Exploitation System (TES)** is the Army's objective TENCAP system for the 21st century and will replace the Advanced Electronic Processing and Dissemination System (AEPDS), the Enhanced Tactical Radar Correlator (ETRAC), and the Modernized Imagery Exploitation System (MIES). TES combines all TENCAP functionality into a single, integrated, scalable system specifically designed for split-based operations.

Figure D-28: TES Forward

This next generation system will serve as the interface between National systems and in-theater tactical forces, as well as directly receiving data from theater and tactical assets. It will receive, process, exploit, and disseminate data from direct down links (DDL) and from ground stations of National and theater platforms.

Designed for split-based deployment, TES consists of Forward and Main elements. The TES Forward is a highly mobile, HMMWV-based element and the TES Main is housed in vans. Each element has similar operational, communications, and support capabilities.

The TES is designed to provide the commander maximum flexibility to satisfy intelligence needs in a wide range of operational scenarios. The TES provides multiple configurations ranging from a one C-130 deployable HMMWV early-entry capability to collocated Main and Forward elements with up to 40 operator workstations. TES operators can perform any Imagery Intelligence (IMINT), Signal Intelligence (SIGINT), cross-intelligence, or dissemination function from any workstation. TES provides quick set-up/ tear-down and C-130 drive-on/drive-off capability to support rapid deployment.

TES will have a robust communications capability, including UHF, S, X, C, and Ku radio frequency (RF) band communications. It will simultaneously receive multiple Tactical and Related Applications Program (TRAP) and Tactical Information Broadcast Systems (TIBS) broadcasts. TES will support full data and voice circuits via tactical and national communications systems. It will also interface with and serve as the preprocessor of the ASAS, Common Ground Station (CGS) and the Digital Topographic Support System (DTSS).

The Division-TES (D-TES) will replace the Mobile Integrated Tactical Terminal (MITT) as the objective Divisional TENCAP system. The D-TES is a HMMWV-mounted, multidiscipline processing and analysis system providing critical links to theater and National assets. The D-TES will have common components to the TES Forward element. Its capabilities will include UHF, GBS and S-band communications; Joint Worldwide Intelligence Communication System (JWICS), Secret Internet Protocol Router Network (SIPRNET), and AUTODIN/ Defense Messaging System (DMS); Imagery and SIGINT processing/analysis; and Imagery storage.

The TES is scheduled for fielding in the FY99-05 timeframe.

The **Graphical Situation Display (GSD)** is a software implementation of MIL-STD 2525, A Common Warfighting Symbology, which standardized the icons and overlays displayed on electronic battlemaps. This software is compliant with DII/COE and GCCS software standards. GSD provides a means of depicting situation information using standard military symbols and graphics on an imagery or map background. This results in the efficient generation and dissemination of a common battlefield vision in support of operations.

The Army had been designated as the lead service to transition the **Semi-Automated IMINT Processing (SAIP)** program ACTD to the acquisition process for production and fielding. The SAIP will automate and enhance imagery analysis tasks and provide an integrated

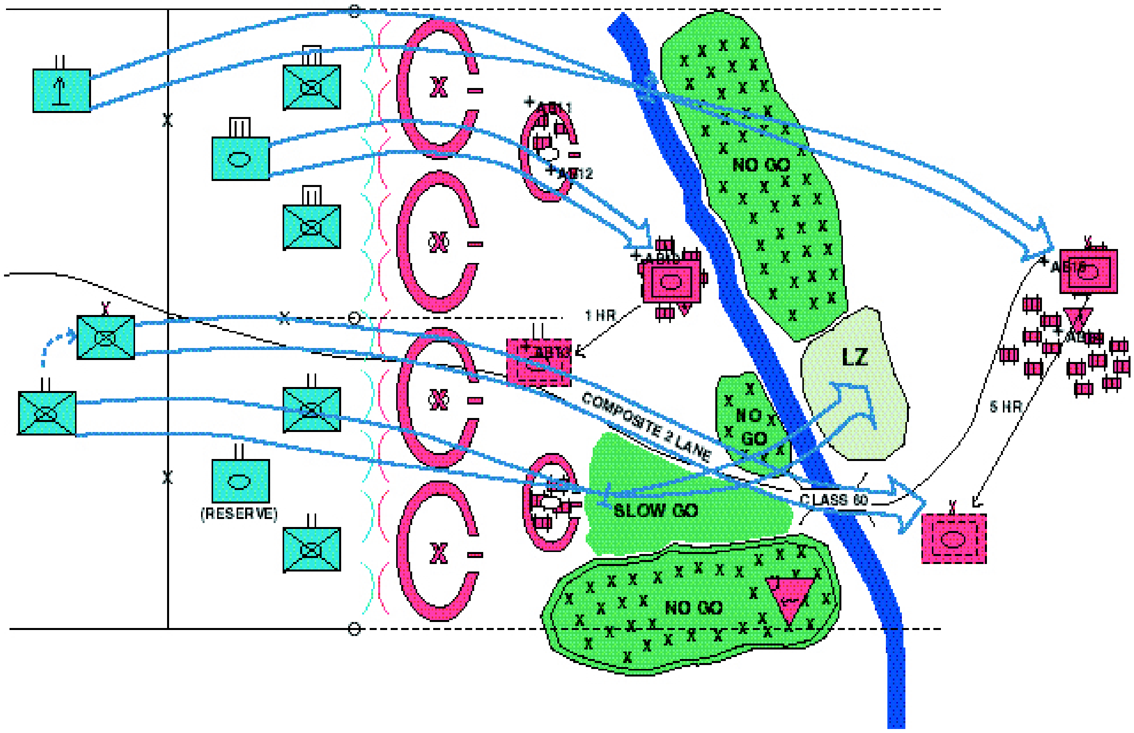


Figure D-29: Graphical Situation Display (GSD)

set of imagery exploitation tools. A key feature of SAIP is Automated Target Recognition (ATR) which will automatically identify and classify targets. SAIP is evolving from a DoD ACTD that was managed by DARPA and sponsored by ACOM. The Army and Air Force will receive the ACTD residual capabilities, which consist of two systems, installed in vans. The Army residual capability will be fielded at XVIII ABC, Fort Bragg, in July 1999.

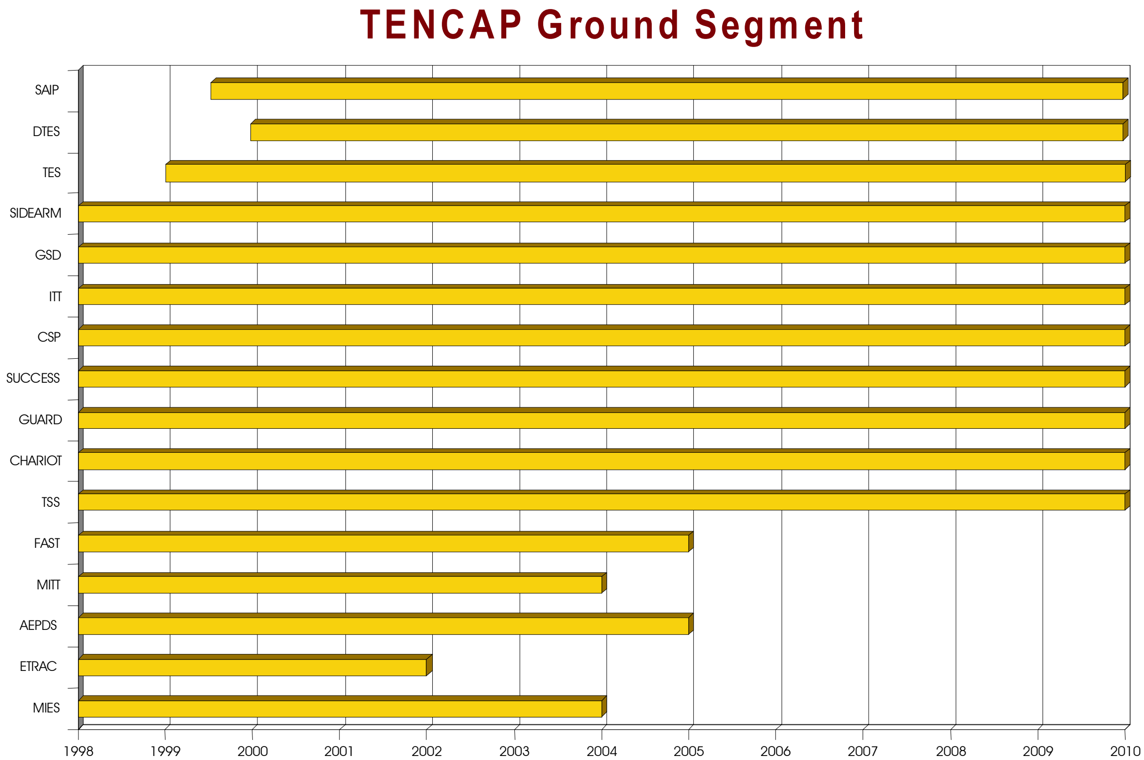


Table D-8: TENCAP Ground Segment Timeline

FOCs Supported:

- SP 97-001 Space Sensor Linked with Terrestrial Systems
- SP 97-002 Passive and Active Target Detection and Processing
- SP 97-004 Support Battle Damage Assessment
- SP 97-005 Space Simulation and Modeling Tools
- SP 97-007 Interoperability
- SP 97-016 Automated/Aided Target Recognition (ATR)
- SP 97-020 Theater Missile Defense

Weather, Terrain, and Environmental Monitoring (WTEM)

The impact that weather has had on military operations throughout history fills volumes. The statement that the weather is seldom neutral is especially significant to the Army. Since the Army is largely a ground force, the same can be said for terrain. Beyond terrain, it is vital to the warfighter to understand and plan for the environment in which he must operate. Foliage, trafficability, dust, and moisture characteristics of the atmosphere are a few examples of environmental data that can be critical to planning and successful execution of an engagement or mission.

The Army is becoming increasingly dependent on maneuver and information dominance. Reliable, up-to-date WTEM information, coupled with a complete historical database, will provide the planner with the help necessary to overcome the disadvantage of operating in in unfamiliar area. Accurate WTEM data will also contribute to achieving other FOCs such as efficient and on-time logistics, essential to sustaining the force.

The USAF has had responsibility for providing meteorological support to DoD agencies since the beginning of the military space program. The low Earth orbit (LEO) space segment consists of the satellites launched and operated under the Defense Meteorological Support Program (DMSP). The Army also uses information

Specifications

Weight: 1750 pounds

Orbit Altitude: Approximately 450 nautical miles

Dimensions: 11 feet, 6 inches high;
4 feet, 9 inches wide;
19 feet, 3 inches long

Power Plant: Solar array generating 1,000 watts

Launch Vehicle: Titan II

Primary Contractor: Martin Marietta Astro Space

Figure D-30: DMSP Satellite

from civilian weather and environmental monitoring satellites which were developed in parallel to the DMSP. Space systems operating in both geosynchronous Earth orbit (GEO) and LEO provide a view of weather patterns in visible and infrared light. These systems produce environmental data including surface temperatures, wind speeds, and cloud coverage on a near real-time basis. Presidential Decision Directive/NSTC-2 signed in May of 1994 directed the DoD, Department of Commerce (DoC), NOAA, and National Aeronautics and Space Administration (NASA) to consolidate their requirements into a merged national weather satellite program. The converged program is the National Polar-orbiting Operational Environmental Satellite System (NPOESS) which will replace the DMSP and the NOAA Polar Orbiting Environmental Satellite (POES). Initial operational capability for the first satellite is scheduled for 2007. The NPOESS will provide more data on atmospheric conditions and provide it faster.

System Characteristics

Constellation:
3 satellites on orbit (min):
2 U.S., 1 European

Orbit Characteristics:
Sun-synchronous polar

Orbit Altitude:
833 km (450 nm)

Satellite Mass:
3,023 kg (6,665 lb) (notional)

Power Plant:
Flexible GaAs Solar Array

Payloads:
Multispectral visible and infrared, microwaved and space environmental

Tracking Stations:
Air Force Satellite Control Network (AFSCN)
Automated Remote Tracking Stations (ARTS)
NOAA Command Data Acquisition (CDA) sites (at Walllops Island, VA, and Fairbanks, AK) and NESDIS (at Suitland, MD)

Figure D-31: NPOESS

Weather, Terrain, and Environmental Monitoring Ground Segments

The current and near term ground stations discussed below are operated by Air Force Combat Weather Teams (CWT) in direct support to corps and division commanders in theater. However, as part of the modernization strategy, plans are underway to expand availability of data using the **Integrated Meteorological System (IMETS)**. IMETS is a mobile tactical automated weather data receiving, processing, and dissemination system designed to provide timely weather and environmental effects forecasts, observations, and decision aid information to multiple command elements at echelons where Air Force weather teams provide weather support to the Army. It is an Army-furnished system that is operated by Air Force personnel.

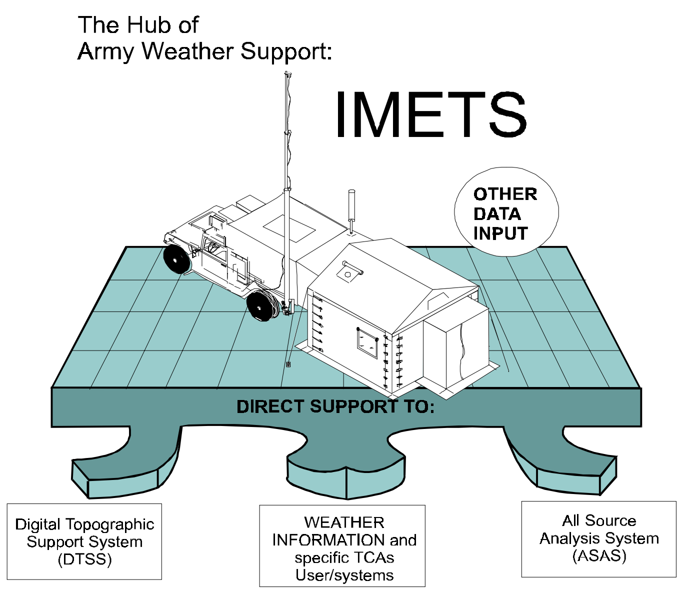


Figure D-32: IMETS

An IMETS Operational Requirements Document (ORD) is under draft and review and addresses the need for three levels of access terminals: dismounted, mounted/dismountable and man-portable. "Dismounted" is a Command Post desktop PC version and is intended to move weather workstations out of vehicles and into the headquarters.

"Mounted/dismountable" is the vehicle-mounted version as currently implemented in the IMETS shelter with two workstations. "Manportable" will be a laptop version suitable for use by small, highly mobile CWTs and connectable to a suitable communication device in order to receive the desired weather data. Accomplishing this require analyzing, modeling and interpreting the raw data obtained from satellites. Agreements between the Army and Air Force regarding IMETS are in the process of being reached through the IMETS Migration Plan. Both the ORD and the IMETS Migration Plan are the responsibility of the US Army Intelligence Center & Ft. Huachuca.

The **Mark IV** weather terminal is housed in an 8 x 8 x 20-foot standard shelter, and is transportable by C-130 aircraft. As a DMSP satellite passes within view of the terminal, data is received, stored, and processed. The system can provide a film hard copy of DMSP imagery, or the image can be transmitted to remote weather detachments by facsimile. While the Air Force has four of these transportable systems and the Marine Corps has twelve terminals, the Army has none in its inventory.

Figure D-33: Mark IV

The **Mark IV-B** is the successor to the system Mark IV weather system. The terminal can access DMSP, TIROS-N, GOES-NEXT, GMS, and METEOSAT weather satellites. It is capable of acquiring and processing data from one polar-orbiting and one geostationary satellite simultaneously. The terminal provides mass storage backup and playback of raw satellite data, and maintains a database for storing and retrieving meteorological information. The Mark IV-B has the capability to manipulate and enhance weather data and satellite imagery in order to produce hard copy transparencies or paper copy products.

Figure D-34: Mark IV-B Console

The **Small Tactical Terminal (STT)** provides worldwide, real-time, tactical weather support to Army forces.

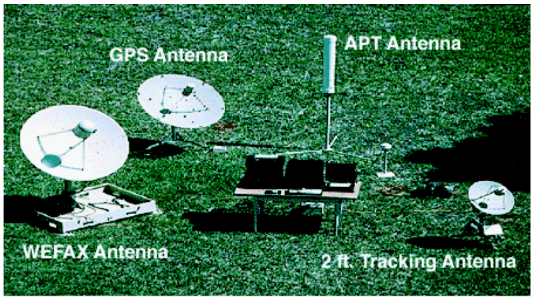


Figure D-35: STT

The system consists of lightweight, portable weather terminals that provide an interactive weather satellite data analysis capability with reliance on surface communications. The terminal can receive, process, store, and display data from the DMSP, TIROS, GOES, GMS, FENG YUN, and METEOSAT satellites.

The **Digital Topographical Support System (DTSS)** is a tactical computer-based system that provides automated assistance to the Army's terrain analysis function and maintains the digital data for the warfighter's terrain evaluation and visualization requirements. It has the capability to receive, format, create, update, manipulate, and merge digital terrain data to produce hardcopy terrain analysis products. It will accept topographic and multispectral imagery data from The National Imagery and Mapping Agency's (NIMA) standard digital databases and other sources. The system has evolved in several configurations. The first version was the DTSS-D (Deployable), with equipment housed in transit cases for ease of set-up and transport. The second version is the DTSS-H (Heavy), which is housed in a 20-foot ISO shelter and mounted on a 5-ton truck chassis. The third and newest version is the DTSS-L (Light), which is housed in a shelter carried by a HMMWV. The fourth version is the DTSS-B (Base) which is set up in a controlled garrison environment and gives the analyst the capability to create terrain data.

Figure D-36: DTSS-L

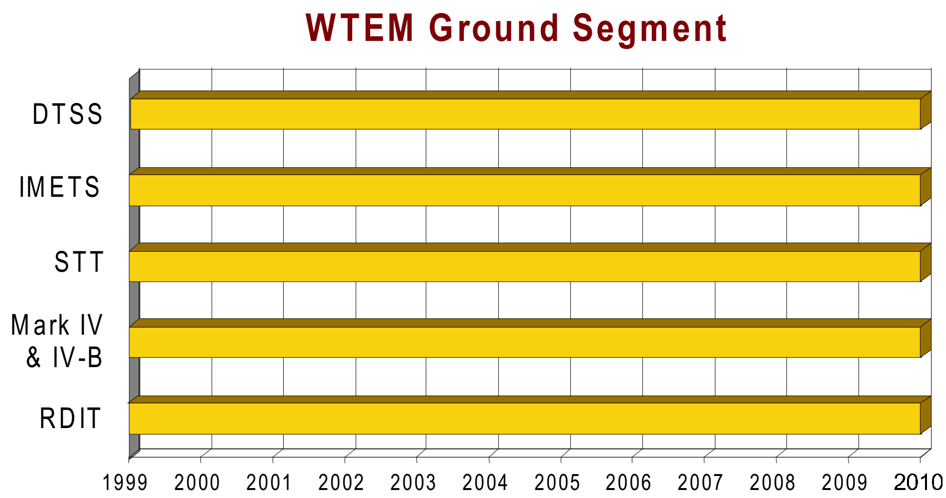


Table D-9: WTEM Ground Segment Timeline

FOCs Supported:

- SP 97-001 Space Sensors Linked with Terrestrial Systems
- SP 97-002 Passive and Active Target Detection and Processing
- SP 97-005 Space Simulation and Modeling Tools
- SP 97-007 Interoperability
- SP 97-014 Collection and Dissemination of Mapping, Charting, and Geodesy (MCG)

Position and Navigation

The **NAVSTAR Global Positioning System (GPS)**, has revolutionized position finding, navigation, and time coordination much the same as COMSATs have done for communications and dissemination of information. In addition, use of GPS as an integral part of Blue Force Tracking and weapons delivery systems can contribute greatly to achieving dominant maneuver and precision engagement while reducing chances of friendly fire casualties. This type of information dominance will allow the conduct of theater conflicts to become largely event and real-time situation driven. Some GPS fielding is partially in response to the Congressionally Directed action contained in the Congressional Record, H9194, 10 November 1993.

"Limitation on procurement of systems not GPS-equipped: After September 30, 2000, funds may not be obligated to modify or procure any Department of Defense aircraft, ship, armored vehicle, or indirect-fire weapon system that is not equipped with a Global Positioning System Receiver."

The GPS space segment consists of a constellation of 24 satellites (plus on-orbit spares), in six near circular orbits at

Specifications

Weight: 1,860 pounds (in orbit)	**Launch Vehicle:** Delta II
Orbit Altitude: 10,900 Miles	**Primary Contractor:** Rockwell International (Boeing North American) - Block, I, II, IIA; Lockhead - Block IIR Boeing North American - Block II
Power Plant: Solar panels (800 w)	
Dimension: 5 Feet wide, 17.5 feet long (length includes wingspan)	

Figure D-37: NAVSTAR Global Positioning System

an altitude slightly under 11,000 nautical miles, giving them a period of rotation about the earth of 12 hours. The Master Control Station is located at Schriever AFB, CO and is operated by the USAF 50th Space Wing.

GPS is a passive system in that no activation or interaction signal is required from the user to obtain pos/nav/time data. Each satellite constantly emits signals, including a satellite ID code, on 2 L-band frequencies that can be picked up by a ground receiver. By tracking multiple satellites the receiver can determine through internal calculations what its location is and also derive an accurate current time. How accurately position and time are calculated is determined by the receivers ability to intercept and interpret either Standard Positioning Service (SPS) or Precise Positioning Service (PPS). Access to PPS is currently limited to select users with documented requirements. SPS provides on the order of 100 meter location accuracy and PPS on the order of 10 meters or better.

The major concern for military users of GPS equipment lies with both the space segment and the ground segment. Jamming and “spoofing” are very real threats to any system dependent on receiving information transmitted in the radio frequency spectrum. The current GPS modernization strategy centers around incorporating AJ/AS capabilities by improving the GPS receivers and increasing signal power from space. R&D efforts in the past two years have concentrated on issues related to broad band jamming, and some system protection has been developed. The current modernization strategy centers around incorporating AJ/AS capabilities and continuing to equip and upgrade the force.

Navigation Ground Segment

The **Precision Lightweight GPS Receiver (PLGR)**, AN/PSN-11 is a small, handheld GPS receiver with Selective Availability/Anti-Spoofing (SA/A-S) and anti-jam capability. It provides positioning and timing information based on the signal received from the GPS satellite constellation. It is a five channel receiver, capable of Precision Code (P-Code) and Y-Code (encrypted P-Code) reception. Positioning solutions can be displayed in latitude, longitude, Military

Figure D-38: PLGR

Grid Reference System, Universal Transverse Mercator, British National Grid, and Irish Transverse Mercator Grid coordinates. The PLGR has a built-in test feature, and is Night Vision Goggle (NVG) compatible. In addition to handheld and ground-mobile use, the receiver is employed in helicopters. The PLGR is used widely in the Army to provide the soldier with navigation, site surveying, field artillery emplacement, target acquisition, and communication systems timing. It improves lethality by providing precise knowledge of the location of friendly and enemy forces. It also supports efficient off-road navigation for supply distribution, vehicle recovery, rendezvous, and reconnaissance. An Enhanced PLGR (EPLGR) is being procured with lower power usage that will result in longer battery life. EPLGR incorporates Differential GPS (DGPS) and a number of other changes that include other data interfaces and 43 new user interfaces/display type functions.

The **Defense Advanced GPS Receiver (DAGR)** is the next generation of handheld GPS receivers planned for procurement. The receiver will ensure that there is no production gap after the last PLGRs are delivered under its current contract. DAGR will have double the battery life of the PLGR.

The **GPS 3A Receiver** is the first DoD GPS receiver widely used in aircraft. It provides highly accurate, all weather navigation and timing information to aircraft allowing precise flight patterns, rendezvous, and weapons delivery. Although the 3A was developed in 1985, it continues to perform well in the field. It has five channels to receive and process five distinct GPS satellite signals simultaneously, and operates with the GPS P-Code on both GPS L1 and L2 frequencies. The 3A has three primary shortcomings. First, it is not field reprogrammable, and must be returned to the depot for upgrade. Second, it does not have an enhanced anti-spoofing function. Last, in comparison to newer GPS receivers, it is large and heavy, and contains several outdated and obsolete components.

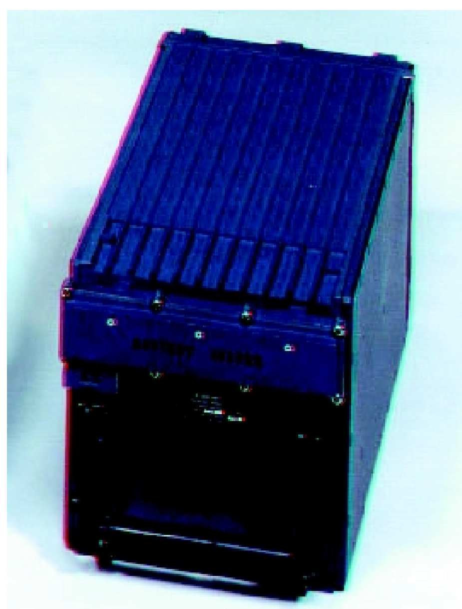


Figure D-39: 3A Receiver

The **Miniaturized Airborne GPS Receiver (MAGR)** is a five channel system that provides P-Code accuracy navigation capability to a variety of airborne platforms. It was developed in 1990 as the answer to the shortfalls of the 3A Receiver. The MAGR is less expensive, smaller, and more reliable than the 3A, and is field reprogrammable. It has a variety of power supply options, and can be fitted with a Precise Positioning Service-Security Module (PPS-SM). To meet the needs of high performance aircraft, 10, 18 and 24 channel receivers have been added to the MAGR production line. The MAGR is a standard airborne system used by all Services. It can accommodate many interfaces, and can be integrated with an existing Inertial Navigation System, Doppler Reference System, or Attitude Heading Reference System.

Figure D-40: MAGR

The **Miniaturized Airborne GPS Receiver 2000 (MAGR-2000)** will be the follow-on to the MAGR. The acquisition objective of the MAGR-2000 will be to continue to support and sustain DOD Project 2000, while improving the performance, operability, supportability, reliability, and maintainability of the current MAGR.

The **Embedded GPS Inertial (EGI) Navigation System** is a modern navigation device that combines a GPS receiver card with an inertial navigation system card, in an integrated unit of modest size and weight. The five channel receiver is being procured by the Air Force's Aeronautical Systems Center (ASC), with the GPS JPO acting as GPS technology consultant and managing the Qualification Test and Evaluation (QT&E) program. The EGI is intended for installation into aircraft (including helicopters) where there are weight/size constraints or where inertial navigation systems are being replaced and economics is a factor.

The **GPS Receiver Applications Module (GRAM)** represents a different approach to supporting future needs. The GPS Joint Program Office has jointly developed with industry a standard to be used by manufacturers who plan to incorporate GPS into any future military system. GRAMs are to be considered members of the family of common DoD user equipment not requiring OSD authorization for procurement and use. This will streamline the acquisition process for the DoD Systems Program Office to embed or implement GPS into their systems. The goals of the GRAM program are to: a) ensure security, interoperability, and interchangeability, b) maintain a number of competitive industry sources for PPS GPS modules, c) reduce proliferation of non-standard interfaces, definitions, functions and performance metrics, d) provide technical definitions that form the basis of a JPO receiver card certification, and e) provide a technically expedient and cost effective host for future capability upgrades.

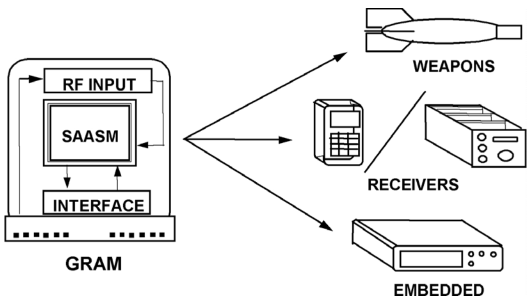


Figure D-41: GRAM

The **Cargo Utility GPS Receiver (CUGR)** is a PPS GPS receiver for military aviation operations. The CUGR can automatically sequence up to 20 flight plans with 20 waypoints each, show the nearest airport, plan vertical descents and display minimum safe altitudes. The receiver is also compatible with Night Vision Goggles. The system will be installed on selected UH-1, UH-60, OH-58 and CH-47 aircraft, and will provide the Army with a receiver that meets FAA requirements for operating under instrument flight rules in national air space beyond the year 2000.

Figure D-42: CUGR

The **Special Operations Lightweight GPS Receiver (SOLGR)** is a self-contained, integrally waterproof, single frequency, PPS capable, handheld GPS receiver with a revised display, improved battery life and improved software to enable fast Time-To-First-Fix and Second-Fix performance. These

Figure D-43: SOLGR

capabilities are important for conservation of battery life and reduction of personnel exposure time. The SOLGR allows SOF units to determine their position without signal masking from trees, buildings, and terrain. The SOLGR allows the user to create sub-modes of operation, tailor the sequence of navigation screen displays associated with each sub-mode, and define a sub-mode specific default. Additionally, the SOLGR has the capabilities to mark point and history file entries, auto leg advance on routes, reverse routes, and select or deselect specific satellites.

The **Standalone Air GPS Receiver (SAGR)** AN/ASN-169, is a six channel PPS-rated receiver intended for use in selected Army helicopters. It is produced by upgrading the AN/PSN-10 Small Lightweight GPS Receiver (SLGR) originally procured during Operation Desert Storm. The SAGR replaces SLGRs currently installed on various Army aircraft. It will use existing SLGR installation brackets but have a new L1/L2

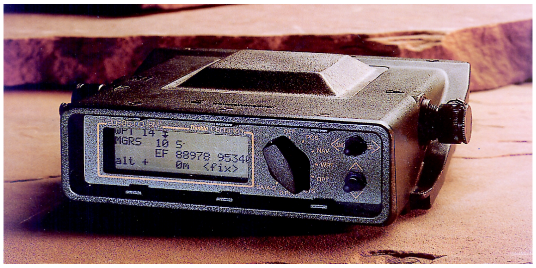


Figure D-44: SAGR

antenna. Mission planning software will be distributed to support SAGR operations, allowing multiple waypoint data to be entered using a computer system. First priority for SAGR installation goes to Army aircraft not currently equipped with GPS systems.

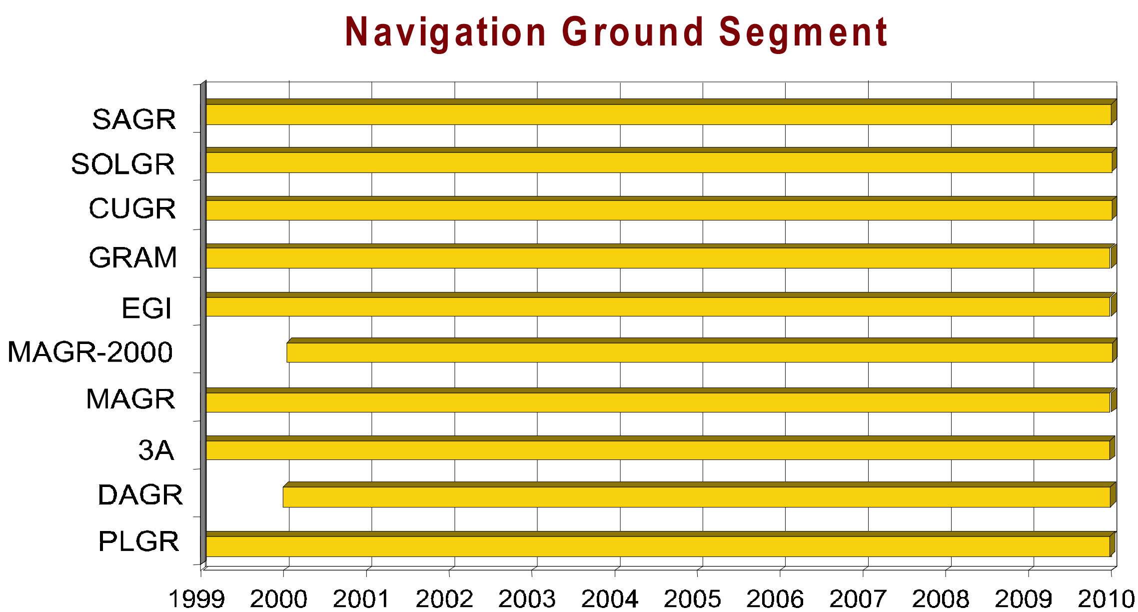


Table D-10: Navigation Ground Segment Timeline

FOCs Supported:

- SP 97-001 Space Sensors Linked with Terrestrial Systems
- SP 97-002 Passive and Active Target Detection and Processing
- SP 97-014 Collection and Dissemination of Mapping, Charting, and Geodesy (MCG)

Missile Warning

Launches of all types of missiles worldwide are currently monitored by the Defense Support Program (DSP) using a constellation of satellites in geosynchronous Earth orbit equipped with a non-imaging infrared sensor system. Data from the satellites are downlinked to fixed multi-purpose facilities, and fixed and mobile ground processing stations. Status and warning messages are distributed by a ground communications network (GCN). Although DSP serves multiple missions, its primary purpose is to provide warning of Intercontinental Ballistic Missile (ICBM) and Submarine Launched Ballistic Missile (SLBM) attacks against the United States. The program was structured to support sufficient warning to allow a National Command Authority (NCA) decision on launching various levels of counterstrike. As theater ballistic missile (TBM) use became more prevalent in regional conflicts it appeared that DSP could support some level of timely warning to theater commanders regarding threat launch azimuth and probable target areas. Desert Storm showed, however, that the system and timelines in place to support strategic response were not adequate to meet the need for warning of shorter range missile attacks, where total flight times are measured in a few minutes.

In response to the experiences of Desert Storm, the Army initiated development of the Joint Tactical Ground Station (JTAGS), an in-theater, forward deployed, transportable facility that directly processes space-based DSP IR data and provides launch warning, probable launch location and probable target area shortly after initial detection (launch or cloud break). JTAGS is considered part of the Theater Event System (TES), which also includes Talon Shield/Attack, Locate, and Early Reporting to Theater (ALERT) fixed sites, a joint Air Force and BMDO program. JTAGS has been developed by the Army through the JTAGS Product Office. The DSP space segments are on-orbit and operational; JTAGS ground segments are operational.

The modernization strategy for missile warning revolves around transitioning JTAGS hardware, software and operations to a system compatible with the next generation early warning system, the Space-Based Infrared System (SBIRS).

Missile Warning Space Segment - DSP

The **Defense Support Program (DSP)** is a survivable and reliable system that uses infrared detectors to sense heat from missile plumes against the earth background, to detect and report in real-time missile launches, space launches and nuclear detonations. The DSP constellation consists of four satellites in GEO plus one on-orbit spare. The system is procured, launched, operated and maintained by the Air Force.

DSP satellites have been the spaceborne segment of NORAD's Integrated Tactical Warning and Attack Assessment System since 1970. The satellites feed warning data, via communications links, to NORAD and US Space Command early warning centers within Cheyenne Mountain. These centers immediately forward data to various agencies and areas of operations around the world. Members of the Air Force Space Command 50th Space Wing's 1st Space Operations Squadron provide command and control support for the satellite.

Specifications

Spacecraft:
Spacecraft spin slowly (6 rpm) about the nadir axis to permit scanning of the Earth by the detector system. Zero momentum stabilized using a reaction wheel to counter the spacecraft spin. Body mounted cells and deployable panels generate roughly 680 W.

Payload:
Payload includes 3.6m Schmidt telescope with 2000 element IR sensor, nuclear detection sensors.

Country of Origin:
United States

Customer/User:
USAF

Manufacturer(s):
TRW

Size:
2.8m dia. By 2.9m tall cylinder

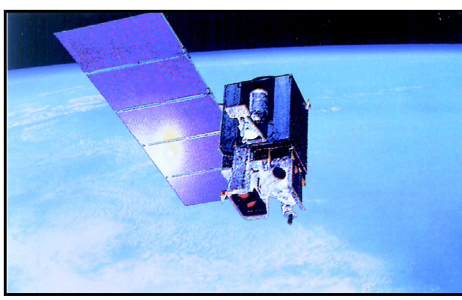
Orbit:
Geosynchronous

Design Life:
3 years (5 years goal)

Figure D-45: DSP

Missile Warning Space Segment - SBIRS

The **Space Based Infrared System (SBIRS)** program is intended to meet the warfighter requirements for missile warning, missile defense, battlespace characterization and technical intelligence in the next century. It will modernize and ultimately replace the Defense Support Program (DSP) that has provided high altitude missile warning for over 20 years. SBIRS will initially replace DSP ground assets and assume the operation of the remaining DSP satellites. These DSP satellites will later be replaced by two new infrared systems-one designed for high altitude orbit (SBIRS-High), and the other for low altitude operation (SBIRS-Low). The SBIRS-High constellation will consist of four satellites in geosynchronous orbit (GEO), and two additional satellites in highly elliptical orbits (HEO) that will provide an enhanced follow-on capability to the current DSP. SBIRS-Low satellites will carry two sensors, one for acquisition, and one for tracking. This low altitude system will provide enhanced missile detection, tracking, discrimination and kill assessment capabilities to perform the increasingly important missions of Integrated Tactical Warning/Attack Assessment (ITW/AA), National Missile Defense (NMD), and Theater Missile Defense (TMD).



System Characteristics

Orbit Characteristics:
Geosynchronous orbits (GEO)
Highly elliptical orbits (HEO)
Low earth orbits (LEO)

Constellation:
GEO: 4 satellites on orbit plus 1 replenishment
HEO: 2 hosted sensors
LEO: (TBD)

Launch:
Compatibility with medium-launch vehicles (contractual requirement)

Other Characteristics:
Multi-mission, flexible sensors (for missile warning and tracking)
Multi-spectral Technical Intelligence

Figure D-46: SBIRS-HIGH

Missile Warning Ground Segment

Figure D-47: JTAGS

The **Joint Tactical Ground Station (JTAGS)** is an air transportable, in-theater information processing system which receives and processes direct down-linked data from the Defense Support Program (DSP) satellite system to warn of Theater Ballistic Missile (TBM) launches. It ties directly to the theater communications systems to disseminate warnings of missile launches, predict impact point and time, and estimate threat launch locations. A JTAGS section includes an 8x8x20-foot shelter equipped with receivers, processors, displays and communications. It is manned by an Army/Navy team of 15 personnel, and is deployed in-theater as a detachment of two sections.

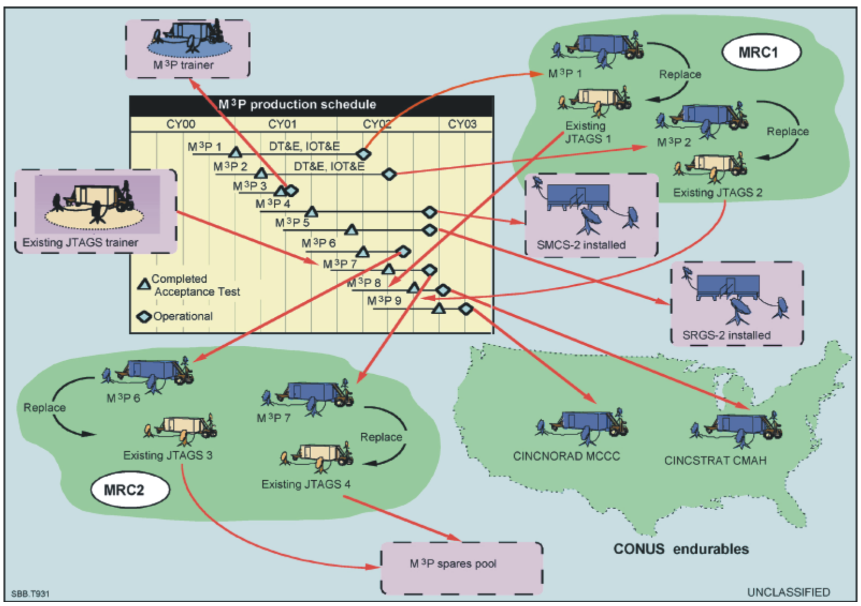


Figure D-48: M3P

The ground segment follow-on to JTAGS is the **Multi-Mission Mobile Processor (M3P)**, a development program jointly funded by the Army and Air Force. SBIRS requirements, including direct downlink of data in-theater, were identified during the OSD C4I Summer Study and validated in the SBIRS JROC on 30 April 1996. A joint study of SBIRS ground architectures led to tri-service agreement on the common M3P design, eliminating development, production, and sustainment of three unique relocatable terminal configurations. This was confirmed in an MOA signed by the three Service Acquisition Executives on 13 September 1996, wherein they agreed to pursue evolution of the JTAGS system as the common mobile processor. Nine M3Ps will be procured—five to be owned and operated by the Army and four by the Air Force.

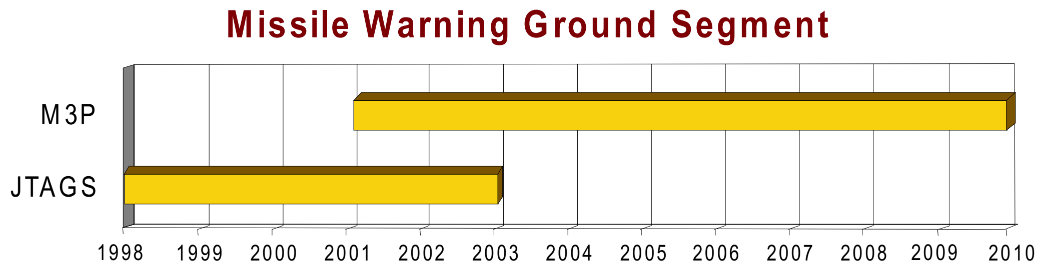


Table D-11: Missile Warning Ground Segment Timeline

FOCs Supported:

- SP 97-001 Space Sensors Linked with Terrestrial Systems
- SP 97-002 Passive and Active Target Detection and Processing
- SP 97-005 Space Simulation and Modeling Tools
- SP 97-007 Interoperability
- SP 97-020 Theater Missile Defense

SPACE CONTROL

The mission area of Space Control is very broad. At one extreme it means denying unfriendly forces access to a satellite capability. Such negation might be mechanically destructive or something subtler, such as an electro-magnetic pulse (EMP) attack. At the other extreme are diplomatic measures to ensure that a commercial or non-US national agency obtaining high resolution imagery does not supply these to an adversary. In between are measures taken by commanders to ensure that key elements or events are not exposed to space surveillance systems by knowing when they will pass overhead and what their capabilities are. Near real-time space situational awareness is as important to an Army regional commander as the enemy's disposition of ground forces. Without knowing when his activities are under surveillance by foreign space systems, a commander could provide an enemy with intelligence that could disrupt future operations. Immediate knowledge of the function and mission of newly launched space vehicles by foreign governments is therefore key to the mission of Space Control. Army space surveillance systems provide data for Space Object Identification (SOI) that is used to determine space system function. Surveillance of space objects also detects system maneuvers that may result in increased surveillance to a high interest area, or possibly a more direct threat to US assets in that region.

The current Army operational contribution to Space Control consists of providing tracking support for objects of all types in orbit. Three radars located at the U.S. Army Kwajalein Atoll (USAKA) facility in the Marshall Islands track active and inactive satellites and provide detailed descriptions of debris size and orbit.

Space Control Ground Segment

ARPA Lincoln C-Band Observable Radar (ALCOR) is on the Island of Roi-Namur, part of the Kwajalein Atoll in the western Pacific, Republic of the Marshall Islands. Operated by the Army, it is primarily used for Anti-Ballistic Missile (ABM) testing in support of the Western Space and Missile Center (WSMC). It supports the USSPACECOM Space Surveillance Mission as a contributing sensor when not performing its ABM role. ALCOR is a near Earth tracking radar, and is one of two radar systems in the Space Surveillance Network (SSN) that can provide wideband Space Object Identification (SOI).

Figure D-49: ALCOR

The **ARPA Long-Range Tracking and Identification Radar (ALTAIR)**, is the key long range acquisition radar on Kwajalein Atoll for ABM testing, and is used to evaluate multiple reentry vehicles. It has a 150-foot diameter antenna, and is the most sensitive radar in the Pacific. ALTAIR can track a 10 square cm target at 40,000

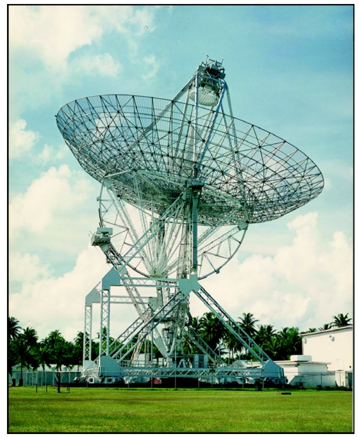


Figure D-50: ALTAIR

km. It is one of three deep space sensors in the USSPACECOM Space Surveillance Network (SSN). Its proximity to the Equator allows ALTAIR to track one-third of the objects in geosynchronous Earth orbit.

Figure D-51: TRADEX

The **Tracking and Discrimination Experiment (TRADEX)** is the original sensor in a program to develop a ballistic missile radar signature database. It has been used increasingly to characterize space debris to determine shielding requirements for the space station.

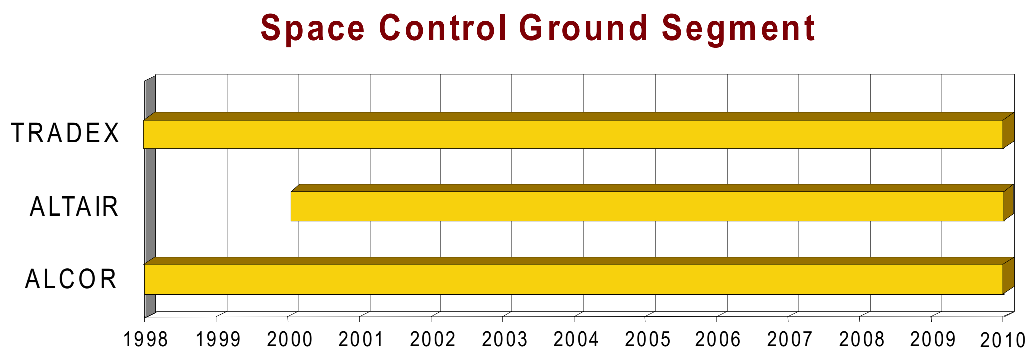


Table D-12: Space Control Ground Segment Timeline

SPACE SUPPORT

The Space Support mission area has contributions from all Services as part of their integration into USSPACECOM in support of USCINCSPACE. The Army's major contribution to space support is provided by ARSPACE. The Command provides for the operations and maintenance of the DSCS. For the near term, the Army modernization strategy is focused on deployment of the Objective DSCS Operation Center (ODOC) described below. Over the longer term, it will be necessary to develop a strategy for ground control operation of SHF systems which is compatible with decisions made about SHF Gapfiller and follow-on systems, whether they be military or commercial.

Space Support Ground Segments

The **Defense Satellite Communications System (DSCS)** provides worldwide SHF communications support to U.S. warfighting forces, strategic military users, the intelligence community and the National Command Authority. Army Space Command DSCS Operations Centers (DSCSOCs) are responsible for the routine command and control of the DSCS satellites, and the communications networks supported by these satellites. The five Army DSCSOCs are operated by the 1st Satellite Control Battalion, and are located in Ft. Detrick, MD; Ft. Meade, MD; Landstuhl, GE; Camp Roberts, CA; and Ft. Buckner, Okinawa, JA.

Figure D-52: DSCSOC

The **Objective DSCS Operations Center (ODOC)** will replace the current DSCSOCs operated by ARSPACE. The ODOC will provide real-time operational control of DSCS satellites and associated ground-based equipment, to include satellite platform control and space segment allocation for communications network. The ODOC will perform all necessary tasks to maintain proper satellite orbit position. The ODOCs will be permanently mounted in a fixed configuration at the locations identified in the DSCSOC paragraph above. CECOM develops and procures the DSCSOC equipment.

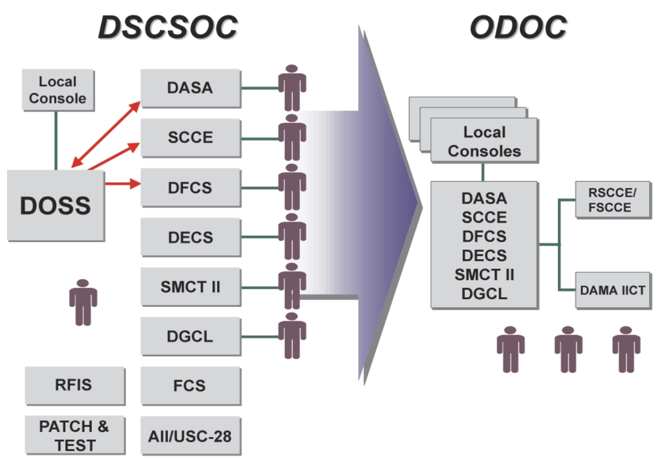


Figure D-53: ODOC

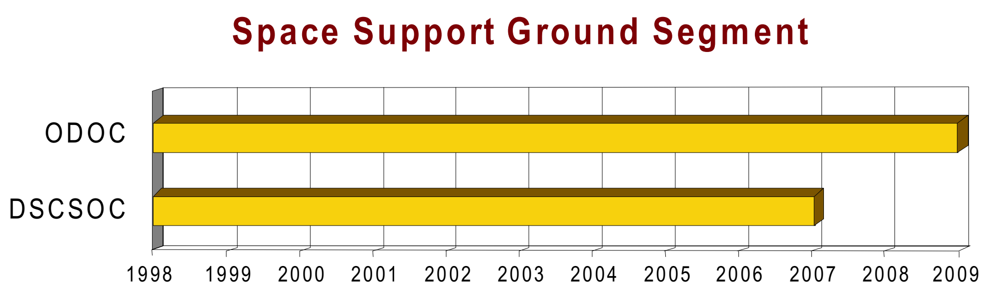


Table D-13: Space Support Ground Segment Timeline

Annex E: Space Initiatives Details

Science & Technology Objectives (STOs)			
Initiative	**Timeframe**	**Organization(s)**	**FOC(s) Supported**
Battlefield Ordnance Awareness (BOA)	FY97-01	SMDTC	SP97-008, 011, 016
Lasercom	FY97-99	SMDTC, BMDO	SP97-001, 007, 009, 011, 012, 014, 015, 017
On the Move SATCOM	FY00-04	CECOM S&TCD	SP97-008, 017
Antennas	FY97-00	CECOM S&TCD	SP97-008, 017
Profiler Data Fusion	FY99-03	ARL-IS&T	SP97-001
Battlespace Tactical Navigation (BTN)	FY99-03	CERDEC/C2SID	SP97-012
High Altitude, High Offset, Precision Airborne Insertion into Restricted Terrain	FY00-03	NRDEC	SP97-001
Point-Hit ATACMS/MLRS	FY99-01	MICOM	SP97-001, 012
Space Surveillance	FY00-04	SMDC	SP97-001, 002, 004, 009
Precision Guided Mortar Munition (PGMM)	FY98-01	ARDEC	SP97-001
Range Extension	FY96-99	CECOM S&TCD	SP97-001, 017
Overhead Passive Sensor Technology Battlefield Awareness	FY97-03	SMDTC	SP97-002

Experiments			
Initiative	**Timeframe**	**Organization(s)**	**FOC(s) Supported**
Joint/Combined Arms Precision Attack	FY99-01	SMDBL, Air Maneuver Battle Lab, Depth and Simultaneous Attack Battle Lab	SP97-001, 005
Battle Command Reengineering 2 Initiative	FY98-99	SMDBL, Mounted Maneuver Battle Lab	SP97-001, 002, 004, 005, 007
Early Warning Experiment	FY99	SMDBL	SP97-020
SBIRS/Air Missile Defense	FY98-03	SMDBL	SP97-005
Space Support to Deep Operations Coordination Cell (DOCC)	FY98-03	SMDBL	SP97-001, 002, 004, 008, 009, 014, 017, 018, 020
Warfighter-1	FY99-00	USAF, ASPO	SP97-001, 002, 009
Exploitation of Constellation Interoperability & Battlefield Mobility Capabilities	FY99	SMDBL	SP97-017
Situational Awareness Human In The Loop	FY99-03	SMDBL	SP97-014
Project Stalker	FY98-99	SMDBL	SP97-001, 009, 014, 020
Joint and Ground Unified Awareness (JAGUAR)	FY99	SMDBL	SP97-002, 007, 009, 014, 020
Signal Support For ForceXXI TOCs CEP	FY98-99	BCBL (Ft. Gordon)	SP97-001, 009
Movement Tracking System/Radio Frequency ID/ Improved CSS Enhancement CEP	FY98-99	CASCOM	SP97-001, 009
KEASAT	FY96-98	SMDC	SP97-021
Courses of Action Wargaming CEP	FY98-99	BCBL (Ft. Leavenworth)	SP97-005

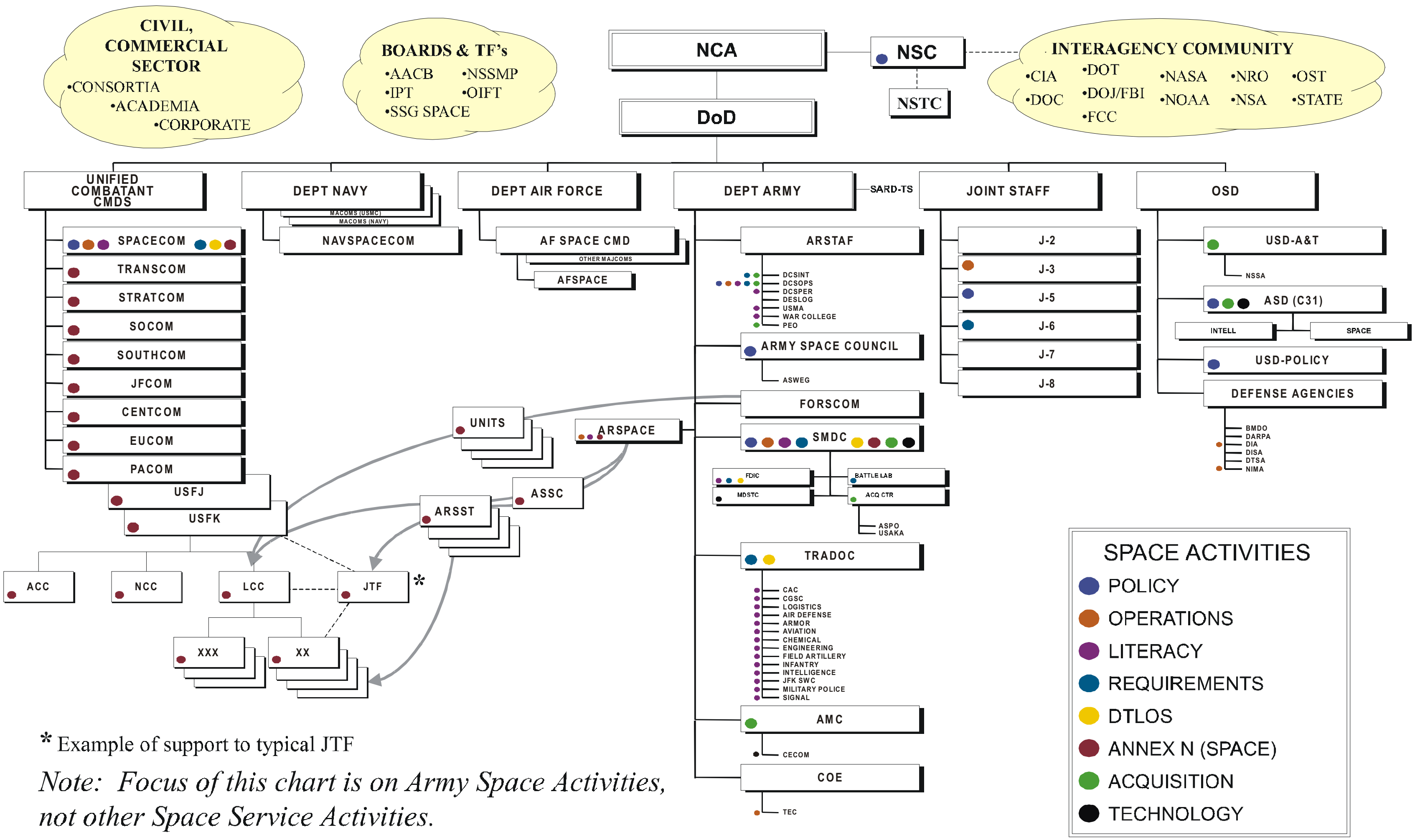
Demonstrations			
Initiative	**Timeframe**	**Organization(s)**	**FOC(s) Supported**
Battlefield C2	FY96-00	SMDBL	SP97-001
Rapid Battlefield Visualization	FY97-00	CECOM	SP97-001
Eagle Vision II	FY98-01	NRO, ASPO, TEC	SP97-015
Sensor Fusion	FY96-03	SMDTC, BMDO	SP97-001
Discoverer II	FY99-07	DARPA, USAF, NRO, SMDC	SP97-002, 009
CCD/IFSAR Project	FY99	ASPO	SP97-001, 002, 009, 014
Terrain Extraction from National Stereo Imagery	(Data Not Available)	ASPO	SP97-001, 014
Automated Feature Extraction from Multisource/ Multispectral Imagery (ACT II)	FY98-99	TEC	SP97-001, 009
Building Feature and Content Prediction Using Knowledge-Based Sensor Fusion (ACT II)	FY98-99	CECOM	SP97-001, 002
CSS Worldwide Web Proposal Enabler Tools (ACTII)	FY98-99	CECOM	SP97-001, 009
Global Broadcast System/ Information Dissemination Management (GBS/IDM) Demonstration	FY98-01	CECOM	SP97-001, 014
Global Broadcast Service (ASEDP)	FY98	SMDBL	SP97-001
Deployable Weather Satellite/Meteorological Automated Sensor and Transceiver	FY98-99	SMDBL	SP97-001, 009
Army Battle Command System (ABCS) Integration	FY98-00	BCBL (Ft. Leavenworth), SMDBL	SP97-008, 009
Low Earth Orbit Communications (LEOCOMM)	FY98-00	SMDBL	SP97-001
DirectPC	FY98	SMDBL	SP97-001
Tactical Automated Situation Receiver	FY98-99	SMDBL	SP97-001
Civil/ Commercial Imagery Systems	FY98-99	SMDBL	SP97-001, 002
Multispectral Automatic Target Exploitation Systems	FY98-00	ASPO	SP97-001, 002
Embedded National Tactical Receiver	FY98-99	NRO, ASPO	SP97-001
PMCIA Embedded National Tactical Receiver	Contract not yet awarded (18 month effort)	NRO, ASPO	SP97-001
Battlespace Weather Characterization and Data Fusion	FY99-00	Army (DCSINT), Air Force	SP97-001, 017
Integration Sensor Picture and Dissemination	FY99-01	ASPO	SP97-001, 009
Embedded GBS Receiver	FY99-00	NRO, ASPO	SP97-001
Digital Battlefield Communications	FY95-99	CECOM	SP97-001, 007, 008
Universal Transaction Information Systems	FY00-04	CECOM	SP97-001, 008

Modeling and Simulation			
Initiative	**Timeframe**	**Organization(s)**	**FOC(s) Supported**
Satellite Architecture Requirement Definition Tool	FY99-00	SMDBL	SP97-005
Mission Rehearsal Training Exercise Proof of Concept Experiment and Related Tools	FY99	SMDBL	SP97-001, 005, 007, 008
Imagery Intelligence Testbed	FY98-03	SMDBL	SP97-001, 002, 004, 005, 014, 016, 017
Optical Data Analysis Technology Program	FY99	SMDTC, BMDO	SP97-005, 020

Studies and Analysis			
Initiative	**Timeframe**	**Organization(s)**	**FOC(s) Supported**
Space Sensor CONOPS Analysis	FY99-03	SMDBL	SP97-020, 021
Environmental Effects on Sensors	FY99	SMDBL	SP97-020, 021
Missile Alert Broadcast System (MABs)	FY97-02	SMDC	SP97-020

ANNEX F

SPACE COMMUNITY STRUCTURE

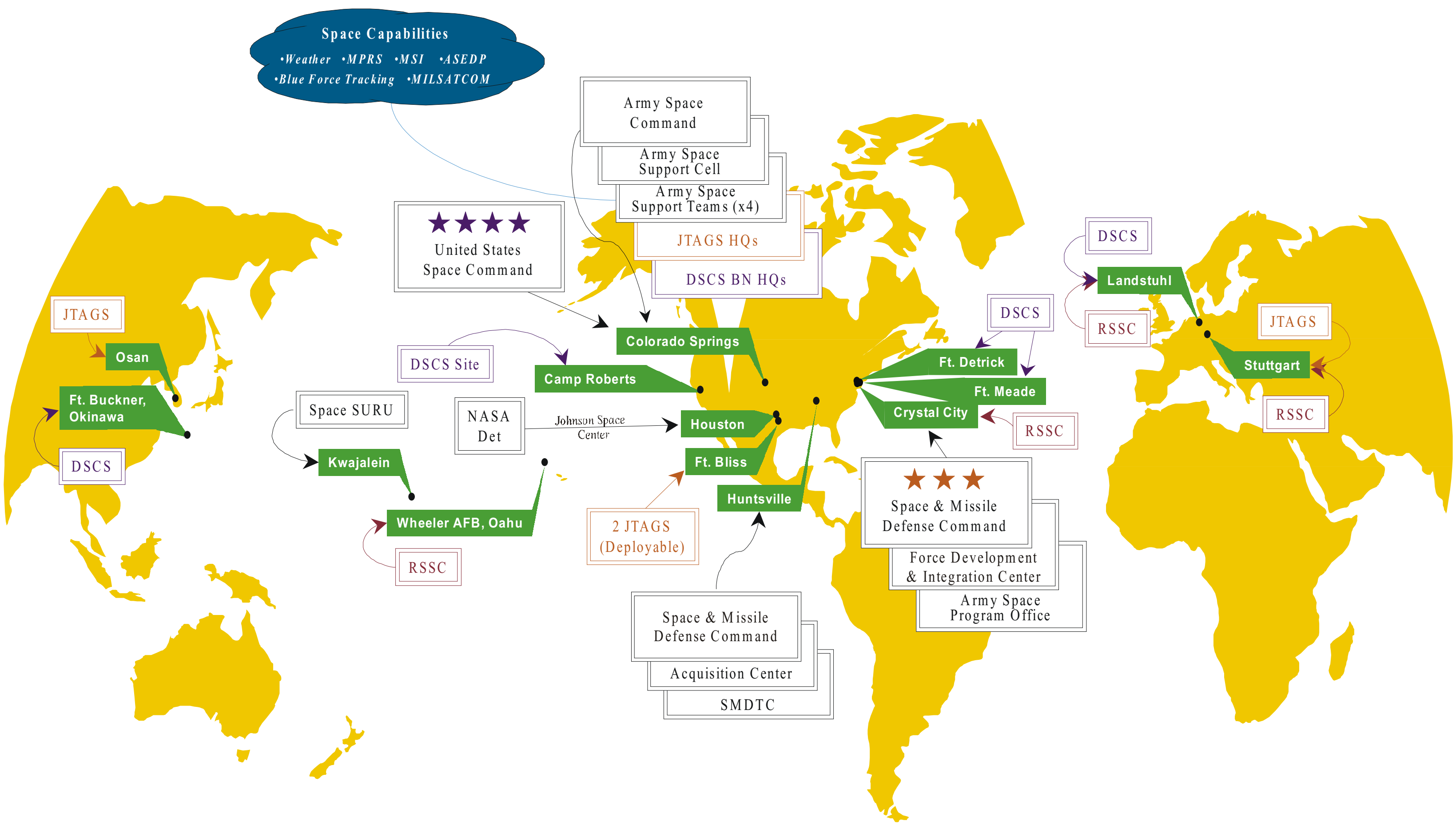


* Example of support to typical JTF

Note: Focus of this chart is on Army Space Activities, not other Space Service Activities.

ANNEX F

Army Space Headquarters and Forces



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"...Space is the high ground in the 21st Century, we understand that. We (the Army) are very dependent on space... and so our effort has been to increase emphasis in terms of Army involvement in Space."

GEN Reimer, CSA - May 20, 1998